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TELEPHONE PATENTS.

OUR report of the proceedings in the case of the United Telephone Company against Bassano and Slater for infringement of the Edison transmitter patent is concluded for the present in this week's issue, and our readers will perceive that on Wednesday last Mr. Justice North, who tried the action, intimated what decision he had come to, although he did not give the usual detailed form of judgment, which he says he has not yet been able to prepare, and for which we shall have to wait until October.

Those who have read the reports which we have given of this case have, no doubt, recognised that it stood upon a different footing to those which preceded it. In former cases the main proof relied upon of infringement in the transmitting instrument has been that there was a material of some sort placed in some part of the speaking portion to serve the purpose of a diaphragm, coming between the mouth of the speaker and the tension regulator, the air motions produced by the sound of the voice, acting upon this diaphragm or plate, producing a vibratory motion, which it communicated to the tension regulator. In the instrument now proceeded against there is no such intercepting plate, the tension regulator being directly open to the sound waves. The absence of that important part of the combination claimed by Edison termed the diaphragm, the defendants relied upon to maintain their patent as independent of that of the plaintiffs; whilst, also, they claimed essential differences in the tension regulator, the other part of the combination.

To drive this important rival out of the field of competition, the United Telephone Company resorted to what appears to us to be the most extraordinary course of alleging that every piece of material used in connection with the instrument in which it is possible to produce a vibratory motion, notwithstanding that it is obviously used and intended for totally distinct purposes, is a diaphragm in the sense in which Edison used the term in his specification, and that it acts in precisely the same manner as Edison's diaphragm acts. In the absence of the reasons which led Mr. Justice North to his conclusion, which reasons we reserve our right to criticise at a future period, we cannot more than form an opinion of what his lordship took to be the main basis of the plaintiffs' claim. But in our view, that which we have just stated broadly represents the claim, and if that be broken down, we cannot see how the defendants' instrument could be ruled within the specification of Edison. The important point, as it seems to us, is, what did Edison mean by the word diaphragm? This is a question which has been many times asked, but never answered in a way that has carried universal conviction. We thought we had got to something like a definite point when Lord Justice Fry delivered his judgment in the Harrison Cox-Walker case; but now, it seems, we are to be thrown back as far as ever from a clear understanding of the term.

We have little more to say upon the subject now. Further comment we reserve until the judge's detailed judgment has been given. It may be added in conclusion, however, that we hope, in consideration of the interests at stake, that Messrs. Bassano and Slater are sufficiently strong to proceed further with the case, and carry it into the Appeal Courts, for though one judge takes such a broad view of the forms and uses of a diaphragm, it is very doubtful whether that view would be upheld by another and higher Court.

THE CRUTO INCANDESCENCE LAMP.

THE Cruto lamp, which attracted so much attention at the Exhibitions of Munich, Vienna, Turin and Paris, and which has been several times described, is well known. According to the measurements we have made (*Zeitschrift für Elektrotechnik*), the lamp consumes 3·4 volt-ampères per standard candle. This is very little, and that good result together with the quality of the carbon, have induced several manufacturers in other countries to undertake the manufacture of the lamps in establishments specially built for the purpose. The construction comprises several stages which we will deal with *seriatim*. They are as follows: preparation of the carbon filament; mounting the filament on platinum; enclosing the filament in the lamp; exhausting the air of the lamps; testing the finished lamps, and, finally, mounting the lamps.

Preparation of the Carbon Filament.

The carbon filaments of most of the incandescence lamps consist of carbonised organic matter, as: bamboo fibre, woollen thread, paper, &c.; they are produced by the amalgamation of very finely pulverised carbon; without mentioning the special preparations which the substance itself has to undergo, the carbonisation requires the use of furnaces, crucibles, and moulds; and the regulation of the resistance as well as the determination of the diameter, offers various difficulties. With the Cruto carbon, which is obtained by the precipitation of carbon on platinum after Wollaston's process, those furnaces, moulds, &c., can be dispensed with, and the resistance of the filament can easily be regulated during the course of the process.

The apparatus in which the precipitation is effected, is simply an oblong glass vessel filled with carburetted hydrogen gas, in which a platinum wire is suspended, which is maintained at a white heat by an electric current. Being in contact with that wire heated to a high temperature, the carburetted hydrogen gas is reduced and the carbon is evenly deposited on the platinum wire; the layer of carbon becomes in its turn incandescent and causes the continued reduction of the gas, so that the precipitation of carbon proceeds uninterruptedly.

The gas used is ethylene or olefiant gas ($C_2 H_4$). It is prepared in large globes from a mixture of one part of alcohol and two parts of pure sulphuric acid.

Before this mixture is introduced into the gasholder, the gas must be several times passed through clean water, or water containing lime and sulphuric

acid, in order to free it from the different substances which are formed at the same time, such as ether, carbonic acid, sulphuric acid, &c. Finally, the gas on leaving the gasholder is dried by chloride of calcium and Nordhâusen sulphuric acid.

The platinum wire itself is prepared by Wollaston's process. It is drawn out to a very small diameter and then coated with silver. The wire thus covered is then drawn through the draw-plate again until its diameter is reduced to about $\frac{1}{100}$ millimetre.

For the preparation of the Cruto filament the necessary length of compound wire, according to the type of lamp, is then measured and cut off. It is bent into U-shape, and its ends are pressed in the springs of the plug which closes the above-mentioned glass vessel. The layer of silver which coats the platinum wire is now dissolved in a bath of dilute nitric acid, and finally, the platinum wire is introduced into the glass vessel, as already mentioned.

The different operations mentioned are effected by females, and the arrangements are practical and exact to such an extent that mistakes are quite out of the question. The wire is stretched and bent on a metal pattern, which is divided into millimetres; it is further subjected to a manipulation which causes it to assume the form of a horseshoe. The bath into which the wire is dipped, in order to free it from its coating of silver, is always maintained at the same level, and by means of a very simple arrangement the wire dips itself always to the same depth into the bath. Special arrangements allow the wires to attain with certainty lengths which do not vary half a millimetre, which is quite sufficient in practice. The wires prepared in this way are arranged on long tables and introduced into the glass vessels which contain the ethylene.

The glass vessels are placed in a vertical position, a tube serving to discharge the gas passes through the plug which closes the upper part of the vessel. The gas is introduced into the vessel by means of a caoutchouc tube which passes through its lower part. Two springs, which are fixed to the neck which supports the glass vessel, secure the plug and cause it to fit tightly by pressing in several sheets of caoutchouc. These springs also convey the current to the platinum wire. The platinum wires contained in the glass vessels are joined up parallel between the main conductors of a Gramme machine. In that circuit is inserted a semi-circular rheostat of 200 ohms divided into ten equal parts; and there is also another rheostat of 30 ohms made up of 2 divisions of 5 ohms, 5 divisions of 2 ohms, and 10 divisions of 1 ohm.

The resistance of the filament is very high. Notwithstanding the difference of potential of the machine of 150 volts, the current is very weak. In order to manage the current better still a movable arm has been adapted, which acts as a shunt to each platinum wire. The oblong glass vessels are arranged symmetrically on both sides of the table and connected to the positive pole by means of a central wire. The current passes from the positive pole through the rheostat, the platinum wire, a commutator, to the negative pole. The shunt circuits are formed by means of two wires which lead from the negative terminal of the machine to all the movable arms.

If we observe the variation of the resistance of the wire during its preparation and if we construct a curve from 10 to 10 ohms, we shall see that the resistance decreases at first, and afterwards increases rapidly, far exceeding the original resistance.

Perhaps this circumstance may be due to the platinum wire fusing at a certain moment, leaving only the carbon filament; or the wire may gradually become carbonised, which would decrease the thickness of the wire. This phenomenon, however, has not yet been satisfactorily explained. As the process continues the resistance decreases again, and the curve becomes very regular. In order that the process of the reduction of the olefiant gas shall not be interrupted, it is necessary to maintain the wire at a high temperature. At the commencement of the process a very weak current will be required. The current is accordingly regulated by means of the rheostat, so that the carbon filament shall always be maintained at the same temperature. The strength of the current increases gradually with the thickness of the wire through which it passes.

A simple arrangement, for which we have to thank M. Thebaudeau, enables us to determine the resistance of the filament in course of preparation very quickly and with sufficient approximate exactness, and to stop the operation as soon as the filament has attained the requisite resistance.

A special arrangement allows of effecting the measurement without interfering with the temperature of the carbon filament. The standard resistance forms one of the arms of a Wheatstone bridge, the filament forms another arm, so that we have only to depress one of the keys of the commutator in order to see whether the filament corresponding with that key is ready or not.

When a current passes through those fine and very flexible wires they are affected by the magnetism of the earth. They must therefore be placed on a plane which is perpendicular to the needle of a dipping needle placed in the magnetic meridian. The support of the glass vessel is therefore movable in such a manner that it can be placed in any necessary position. But besides this action of the earth there is also the repulsion between two parallel currents in opposite direction, which affects the wire, causing the two parts of the loop to repel each other. Under this influence the horse-shoe becomes round; in order to counteract this the direction of the current must be changed by a commutator as soon as the filament begins to become non-rigid; as soon as the proper horse-shoe form is restored the current is turned again in its original direction. If this change is made too suddenly the filament assumes the form of fig. 8 with the upper part open.

It is easy to set the filament in motion by means of a magnet, and in practice a magnet is employed to restore the shape of the filaments disfigured during the manipulations.

The reaction, in consequence of which the precipitation of the carbon takes place, is not easily explained from a chemical point of view. As regards the reduction of the pure gas, the only explanation we have is that afforded by the experiments made by Berthelot, but that is by no means complete. We wish to point out that the apparatus used for the preparation of the filament may, with advantage, be used for the study of the reduction of the olefiant gas. If the gradual precipitation of carbon proceeds regularly the result is a homogeneous and compact filament, but if from some reason this was not the case the filament has the appearance as if it consisted of tubes pushed into each other; the filament cannot then be used, for as soon as the current passes through, it breaks and scales. The duration of the process of the preparation of a carbon filament by the electro-chemical precipitation of the carbon is, on the average, two hours and a half.

Mounting the Filament on Platinum.

The mounting of the filament on the platinum wires which must be sealed into the glass bulb is effected in the following manner: the platinum wires are hollowed out at one end, and the carbon filament is fixed in those hollows by means of a precipitation of carbon. The filament is enclosed in a groove of the shape of an inverted U; opposite the ends of the filament are the hollow ends of the platinum wires. The precipitation of carbon caused by the reduction of the ethylene assumes the form of a spindle which firmly unites the platinum and the filament.

This mode of mounting the filament is very good. It never fails. It is preferable to all cements used, to precipitation of copper, or to mounting with points of porous carbon. The filament which is to be mounted is placed with a rheostat in a branch circuit of the dynamo machine; as the layer of carbon becomes

thicker the resistance must be decreased. In this case the precipitation proceeds very rapidly ; the reaction is less than was the case during the preparation of the filament, but it causes a smoky-black deposit, which contains more or less tar.

Enclosing the Filament in the Lamp.

This stage of the construction of the Cruto lamp offers no novel features. We will therefore pass on to the next stage.

Exhausting the Air of the Lamps.

The most delicate part of the construction of the incandescence lamp is the exhaustion of the air. It is effected by means of the Sprengel air pump. The pump is provided with a well filled with a powerful absorbant of water, such as sulphuric acid or phosphoric anhydride, the lamp which is to be exhausted being mounted on a tube soldered to that well. The carbon filament of the lamp is in connection with a rheostat and a dynamo machine ; as soon as the lamp is sufficiently exhausted a weak current is sent ; the rarified gases escape then much more rapidly. The current is gradually increased to the normal intensity required by the lamp. As soon as no more air bubbles are observed in the mercury the current must be interrupted. The lamp is then sealed and tested.

The management of the air pump requires very great care. The mercury, for instance, must be dry and free from dirt. It is also essential to keep it always clean. For this purpose it is washed with sulphuric acid, and before it is introduced into the air pump it is passed through an atmosphere dried by chloride of calcium, and through a bath of sulphuric acid. The lamps are also subjected to a thoroughly dry current of air before they are placed on the air pump.

Testing the Finished Lamps.

The finished lamps are taken into the test room for the purpose of having their lighting power and consumption of energy tested. The lamp, when tested, is marked with the number of ampères and volts corresponding with the standard lamp.

Mounting the Lamps.

The mode followed for the Cruto lamp may be reckoned amongst the best (fig. 1).

The types of the lamps, with their constants, are given in the following table :—

Type.	Candles.	E, volts.	J, ampères.
—	32	100	1·05
A*	20	100	0·60
B	10	50	0·60
C	16	50	1·05
D	8	25	1·05
E	50	50	2·30
F*	100	90	2·25

* 2 carbons.

A SIMPLE AMPÈREMETER.

IN describing the electric light installation in the Town Hall, Vienna, Mr. J. Kareis, in an article communicated to *La Lumière Electrique*, writes :—

The ampèremeter used is graduated not in ampères but in lamps, so that the superintendents can immediately take account of the number of lamps which they are able to supply.

The instruments of measurement, among which is the ampèremeter, represented in fig. 1, are based upon

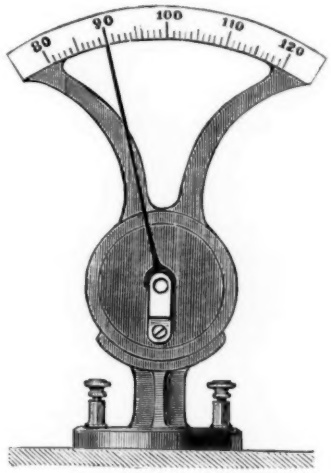


FIG. 1.

magnetic repulsion, and are very sensitive, and at the same time of a simple construction. The indications obtained are invariable, as neither permanent magnets nor springs are employed ; the only agents being gravitation and magnetic repulsion.

The apparatus, of which fig. 1 gives a general view, is composed of a horizontal bobbin provided with two cores of soft iron, one of which, *a*, fig. 2, is fixed, whilst the other, *b*, is movable around an axle mounted

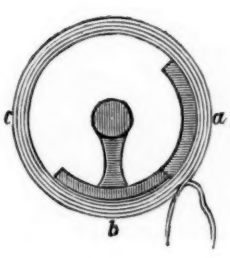


FIG. 2.

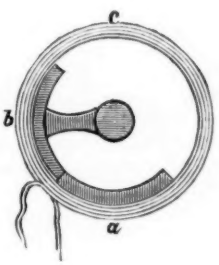


FIG. 3.

on points, and coinciding with the geometrical axis of the bobbin. Each core represents the fourth part of a cylindrical tube.

The movable core tends to occupy, under the influence of its own weight, the position *b* ; the magnetic repulsion, on the other hand, directs it towards the position *c*, so that under the influence of these two forces it occupies a position of mean equilibrium indicated by a needle on a graduated limb.

If it is desired that the instrument should indicate slight intensities of current, that is to say that the needle, when at rest, should occupy the zero of the scale, the movable core and the fixed core should be placed in the position indicated in fig. 2. But as in practice it is sufficient to know the indications within

C

certain limits, we may be content, *e.g.*, in an installation of glow lamps to have a scale graduated from 80 to 120, which enables the sensitiveness of the apparatus to be increased. In this case the relative position of fig. 3 will be selected.

In proportion as the movable core approaches the boundary position, *c*, the effort due to gravitation diminishes, whilst the magnetic repulsion increases. It is seen, therefore, that the sensitiveness of the instrument may be varied by simply changing the position of the fixed core. In an apparatus where the needle is only 150 millimetres in length a volt is represented by the length of 1 centimetre upon the scale.

These instruments are manufactured by B. Egger and Co., of Vienna.

THE ZIPERNOWSKI-DERI TRANSFORMER.

WE have recently made our readers familiar with the theoretical and experimental researches of Professor Galileo Ferraris upon the Gaulard-Gibbs secondary generators. In our last issue we completed the description of a second method of utilising induction coils for the purpose of distributing electrical energy, the invention of Messrs. Zipernowski and Déri.

The learned Italian Professor has communicated to our contemporary *La Lumière Electrique* an article of much interest, from which a correct estimate of the relative values of the two methods may be gathered. As we have dealt very fully with all matters concerning these various induction coils, from the time the apparatus of Gaulard and Gibbs was exhibited at the Royal Aquarium, we need be under no hesitation in reproducing in its entirety the result of Prof. Ferraris's investigation which is thus set forth :—

Thanks to the kindness of MM. Ganz & Co. of Buda-Pesth, I have been able to study in my laboratory at the Italian Museum of Industry, in Turin, a transformer or secondary generator of the system invented by the engineers Zipernowski, Déri and Bláthy. In the second half of June last I made with this apparatus certain experiments and measurements which enabled me to study the system of distribution recently proposed by the engineers just named.

This study naturally resolves itself into two parts: the one relating to the transformer or secondary generator properly so called, and the other relating to the complete system of electric distribution of which the transformer is merely an organ. My present experiments concern the first of these parts only. Still the results obtained are so favourable that they acquire a certain importance of themselves and deserve to be made known. On this account I believe it will not be useless to devote at present a summary notice to the results obtained.

Let us call i^2 and i'^2 the means of the squares of the intensities of the primary and secondary currents; q and q' the quantities of energy expended in the tranformer in a unit of time, and which it restores in the same time in the outer part of the secondary circuit;

$k = \frac{q}{q'}$ the relation between the energy restored and the energy expended, *i.e.*, the coefficient of yield of the transformer.

The magnitudes which it is necessary to know in order to judge the qualities of a transformer are essentially the following:

1. The ratio $\left(\frac{i}{i'}\right)^2$. The apparatus is the more advantageous the lower this ratio; because it is the necessary condition if we wish that for given values of i and of the resistance of the primary circuit the quantity of energy transformed into heat in this latter circuit should be the smallest possible.

2. The coefficient of yield, k. This coefficient should be as large as possible.

3. The resistance $\frac{q'}{i'^2}$ which multiplied by the mean value of the square of the strength of the primary current gives as product the energy usefully transformed by the apparatus. This resistance gives an idea of the power of the transformer and should be as large as possible if we wish to transform large quantities of energy with a small apparatus.

If we represent by n the number of periods, *i.e.*, by $2n$ the number of reversals of the current during a second;

By r' the total resistance of the secondary circuit;

By ρ and ρ' the resistances of the two primary and secondary coils;

By M the coefficient of mutual induction between the primary coil and the secondary coil and by L′ the coefficient of self-induction of the secondary coil, and if, setting out from what I have demonstrated in my work on the Gaulard and Gibbs secondary generator, we neglect as a first approximation the heat developed in the iron, we can easily demonstrate that the above magnitudes may be given by the formulæ:

$$\left(\frac{i}{i'}\right)^2 = \left(\frac{L'}{M}\right)^2 + \frac{r'^2}{4\pi^2 n^2 M^2} \qquad (1)$$

$$k = \frac{r' - \rho'}{r' + \rho\left(\frac{i}{i'}\right)^2} = \frac{r' - \rho'}{r' + \rho\left(\frac{L'}{M}\right)^2 + \rho\frac{r'^2}{4\pi^2 n^2 M^2}} \qquad (2)$$

$$\frac{q'}{i'^2} = \frac{r' - \rho'}{\left(\frac{i}{i'}\right)^2} = \frac{r' - \rho'}{\left(\frac{L'}{M}\right)^2 + \frac{r'^2}{4\pi^2 n^2 M^2}} \qquad (3)$$

For given values of r', of n and of the ratio $\frac{L'}{M}$ the value (1) diminishes when M and L′ increase, and the values (2) and (3) increase when M and L′ increase, or when ρ and ρ' diminish. Therefore the conditions necessary for a good transformer may be summed up thus:

With a given weight of copper the internal resistances, ρ and ρ', must be the smallest possible to obtain very great coefficients of induction, M and L′.

The experiments which I performed on June 19th, 20th, 22nd, and 23rd, had for their object to determine the coefficients of induction, M and L′, for a Zipernowski, Déri and Bláthy transformer.

This transformer had been constructed to yield 3,000 watts. It was of an annular form. The primary and secondary coils are within, and constitute the core of the ring; the iron, on the contrary, is on the outside. It is a fine iron wire, coiled upon the copper helices like Gramme's spiral is upon the core of iron wire. The primary helix is formed of a copper wire of 2·5 millimetres in diameter, making 216 spirals. The secondary helices are two in number, each composed of 54 spirals of a copper wire of 3·5 millimetres in diameter. They can be connected at pleasure either in series or in quantity by making use of a very simple commutator. In the former case the ratio of transformation is about 1 : 2; in the second case about 1 : 4.

The total weight of copper wire is 14 kilos.; the weight of the entire apparatus is about 34 kilos.

The resistances, measured at 68 Fahr., are as follows:—

Primary helix	0·562	ohms.
Secondary helices	0·072	,,
... ...	0·063	,,
The two secondaries in series ...	0·138	,,
The same, in quantity	0·034	,,

To determine the coefficients of induction, M and L′, I made use of Mascart's quadrant electrometer. With this instrument, used according to Joubert's method, I

measured the values of $\left(\frac{i}{i'}\right)^2$ corresponding to the known values of n, and to a series of values of the resistance, r', comprised between 1·74 and 17·73 ohms; I then calculated the values of M and L′ by means of the formula (1), employing the method of least squares.

On experimenting with the secondary helices grouped in tension I found the following results :—

$$M = 0{\cdot}225,\ L' = 0{\cdot}117$$

$$\frac{L'}{M} = 0{\cdot}520.$$

Taking these results as a basis, it is possible to make a comparison between the annular transformer of Zipernowski, Déri and Bláthy, and the secondary generator of the Gaulard and Gibbs type.

If we wish with Gaulard and Gibbs's disc apparatus to obtain a transformer of about 3,000 watts, having a ratio of transformation of about 1 : 2, we may combine two columns of two horse-power by grouping the two primary helices in series, and the two secondaries in quantity. It is therefore sufficient, from our present point of view, to compare such a system with the annular transformer just described.

The Gaulard and Gibbs secondary generator of two horse-power has been the subject of the well-known experiments of M. Uzel, and those which I have made myself, and which I have described in the memoir referred to above. We may therefore make use of the figures which I have deduced from these experiments.

In order that the comparison may be as favourable as possible to the secondary generator of Gaulard and Gibbs, we will suppose that this apparatus is provided with a core entirely of iron. In this case I found that, according to Uzel's experiments,

$$2\,n\,\pi\,M = 2\,n\,\pi\,L' = 26{\cdot}3.$$

On accepting this figure, and remarking that in the experiments of M. Uzel, as in all those made at the Turin Exhibition, we had $2\,n = 268$, we find for a single Gaulard and Gibbs column :

$$M = L' = 0{\cdot}0312,$$

and for the system of two columns

$$M = 0{\cdot}0625 \quad . \quad L' = 0{\cdot}0312.$$

We have, further, as regards the resistances and the weights the following data :—

Resistance of two primary helices grouped in series	0·560	ohm.
Resistance of two secondary helices grouped in quantity	0·142	„
Total weight of copper in discs ...	36	kilos.
Total weight of two columns ...	40	„

We find at once from these figures that the annular transformer of Zipernowsky, Déri and Bláthy has internal resistances almost equal to those of the Gaulard and Gibbs system of columns, but that at the same time it contains only two-fifths of the weight of copper of the latter, and, what is most important, its present coefficients of induction, M and L′, are 3·6 times greater.

The superiority of the annular transformer over the secondary disc generators is therefore evident and considerable.

We can form an idea of the great difference of the effects obtained with these two types of apparatus by the aid of the formulæ (1), (2), and (3). Supposing, for simplicity's sake, that $\frac{L'}{M}$ had exactly the same value in both cases, and remarking that ρ and ρ' have been found almost exactly equal in the two apparatus, we see that the formulæ (1), (2), (3), give for $\left(\frac{i}{i'}\right)^2$ k, and $\frac{q'}{i^2}$ equal values for both apparatus whenever we give the same value to the product n M. That is to say, that the Zipernowski, Déri and Bláthy transformer acts under the same economic conditions, and with the same power as the Gaulard and Gibbs secondary generators, provided that the values of n with which the two apparatus are made to work are between themselves inversely as the coefficients of induction, M. As we have found that the value of M for the annular transformer is equal to 3·6 times that of the Gaulard and Gibbs secondary generator, we are authorised to say that to make the two apparatus act with the same power, and under the same economic conditions, the number of reversals of the current which actuates the former must be to the number of reversals of that which actuates the second as 1 : 3·6.

To have the desired power and to act under normal conditions, the secondary disc-generator of Gaulard and Gibbs demands a number, $2\,n$, of reversals of current equal to about 268 per second, as took place during the experiments at the Turin Exhibition. The Zipernowski, Déri and Bláthy annular transformer would have the same power, and would work under the same economic conditions with a current reversed only $\frac{268}{3{\cdot}6} = 74{\cdot}4$ times per second.

MM. Zipernowski, Déri and Bláthy employ habitually the figure $2\,n = 100$; in this manner the conditions of the power and economy of their apparatus are decidedly better than those just considered.

To render our comparison clearer, we may further compare the powers which the two transformers would have if both were actuated with the same number of reversals of the current, and if we suppose precisely $2\,n = 100$. To fix all the conditions of the problem, we will take also a determinate value for r', putting, for example, $r' = 6$ ohms. We find then for $\frac{q'}{i^2}$ the following values :—

For the system of 2 columns, Gaulard and Gibbs:	$\frac{5{\cdot}86}{0{\cdot}364}$
For the annular transformer	$\frac{5{\cdot}86}{0{\cdot}277}$

These values are to each other as

$$277 : 364$$

that is to say as 1 : 1·31, or almost as 3 : 4.

If instead of comparing the absolute powers we compare the powers referred to the unit in weight of copper, we find that the power of the annular transformer is to that of the Gaulard and Gibbs columns as

$$\frac{364}{14} : \frac{277}{36} \quad \text{or as} \quad 3{\cdot}38 : 1.$$

The comparisons which we have just made are sufficient to demonstrate that the form of the annular transformer is much better than that of the disc secondary generators. This is easily explained, for we can demonstrate *a priori* that the form of the annular transformer is not merely very rational but that it is, perhaps, the best of all that could be devised for the purpose of obtaining great coefficients of induction with low resistances and small weights of copper.

In fact :

1. To have a large surface of spirals with the smallest possible mass of metal, we must remove as much as possible of the metal from the centre of the spirals, and consequently, we must prefer wire to discs.

2. To obtain the largest total surface of spirals possible with the least length of wire, we must have a small number of spirals with a great diameter.

3. To give the iron core the maximum of efficacy it is useful to give it a closed form. Now the layer of iron which covers the annular transformer is evidently equivalent to a core closed upon itself.

4. To avoid Foucault currents the continuity of the iron must be interrupted precisely as it is done by employing instead of a single mass, a varnished iron wire, rolled up in such a manner as to be everywhere perpendicular to the currents.

We are thus led, quite naturally, to the arrangement adopted by Zipernowski, Déri and Bláthy.

Lastly, it must be noted that the induction produced by the currents which circulate in the coils of the annular transformer is sensibly independent of the place which these coils occupy in the interior of the stratum of iron, where they are entirely enclosed, and that consequently, both in the annular transformer and in that with discs, the primary and secondary coils are under identical conditions as regards the iron.

WALKER'S WATTMETER.

THIS instrument, which is shown in fig. 1, consists of two solenoids, one rigidly attached to the stand and the other free to move up and down within it. The latter gives motion to an arm, or lever, which carries a stylus or self-inking pen at its extremity. A cylinder, which is rotated by means of clockwork, carries a card round its surface, which is ruled to represent suitable ordinates; upon this card the self-inking stylus marks a zero or datum line when no current is passing through

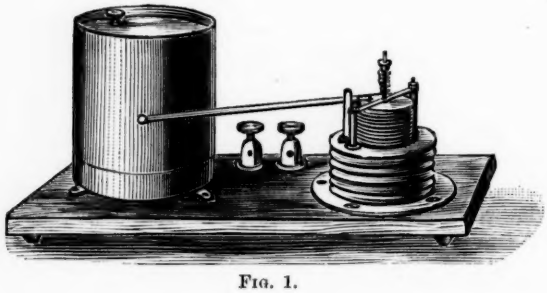


FIG. 1.

the solenoids, but rising, and describing a curve which represents the energy of such a current when the instrument is placed in an electrical circuit. Fig 2 represents a sectional view of the solenoids, A being wound with thick wire, carrying the whole of the

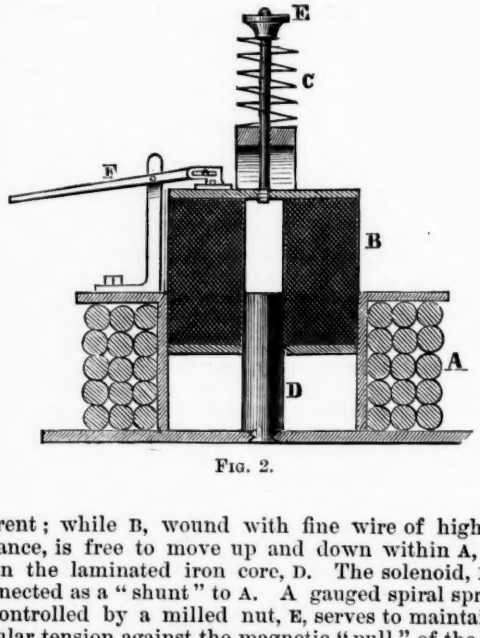


FIG. 2.

current; while B, wound with fine wire of high resistance, is free to move up and down within A, and upon the laminated iron core, D. The solenoid, B, is connected as a "shunt" to A. A gauged spiral spring, C, controlled by a milled nut, E, serves to maintain a regular tension against the magnetic "pull" of the two solenoids. The lever, F, is suitably pivotted, and moved by the descent of the solenoid, B, so that the stylus at the extremity has a wide range.

This instrument may be made to register electrical energy with sufficient accuracy for ordinary purposes, such as charging accumulators, &c., where it is important to know the amount of energy stored; also for testing primary batteries, or a meter in electric light installations.

This apparatus is the invention of Mr. Frederick Walker, and is an improvement upon that described and illustrated in the ELECTRICAL REVIEW of September 27th, 1884.

AMERICAN BOILER TESTS

THE following facts, taken from the report on the boiler trials at the International Electrical Exhibition, Philadelphia, 1884, will be read with advantage by those of our readers who are electrical engineers and who have, in estimating for an electric lighting installation, to consider the most economical form of boiler to use with their generating plant. A comparison of the results obtained from the boilers under notice with those of our makers in England will doubtless prove of very great interest.

The expert in immediate charge of the test, who seems to have had almost exclusive control of the execution, was Mr. H. W. Spangler, assistant engineer, U.S. Navy.

The water fed to the boiler was taken alternately from two large tanks, each holding about 2,400 pounds of water when full. The coal, which was dry, was weighed in barrows. The ashes were weighed dry, and at the end of the test the fire was drawn, and where any unburnt coal came from the furnace, it was credited to the coal account. Barometer and thermometer readings of the air were kept, and temperature of steam recorded by a monitor thermometer, and pressure recorded by Crosby and by Edson gauges. The Fisher and the Webb draft gauges were used, both giving the same results.

As to the determination of the quality of steam, the report says: "The data were taken as carefully as could be, but the imperfections of the apparatus were such that it is a matter of much doubt as to how much reliance can be placed on the results; two different methods of testing the quality of the steam from each boiler were employed, and the results vary so much that no conclusions can be drawn as to the degree of accuracy of either." This refers to the different barrel calorimeters and to the surface condenser continuous calorimeter (the Barrus). The quality of the gases of combustion was ascertained by volumetric measurement.

In making the boiler tests, steam was first raised to the working pressure in each boiler, and the fires were then hauled. All wood and coal used thereafter was weighed, and at the end of the test the fire was hauled and any unburnt coal credited to the boiler. The long duration of trial eliminates any small discrepancies arising from differences of initial heat in boilers, and the like.

The Root and Harrison boilers are too well known to need description. The Dickson boiler, manufactured by the Dickson Manufacturing Company, Scranton, Pennsylvania, is of the horizontal tubular type, having 68 3-inch tubes, each 15 feet long. It has a spread fire box, wider at the top than at the bottom, 6 feet 6 inches by 4 feet 10 inches. The shell is cylindrical, 50 inches in diameter, and is 34½ feet long. The steam dome is 30 inches by 30 inches.

The Baldwin boiler, manufactured by the Baldwin Locomotive Works, is of the horizontal cylindrical flue type, 16 feet long, 54 inches diameter, and having 4-inch flues. The bottom of the boiler was set 34 inches above the grate. Over the boiler is placed a horizontal steam drum 8 feet long and 24 inches diameter, connected to the boiler by means of a vertical neck 12 inches in diameter and 10 inches long.

With these preliminaries noted, we may at once print the table giving the

Resumé of Results Obtained in Boiler Tests.

NAME OF BOILER ON TRIAL.	ROOT.	HARRISON.	DICKSON.	BALDWIN.
Date of trial.	Oct. 2, 1884.	Oct. 9.	Oct. 13.	Oct. 24.
Durations of trials in hours	36	36	36	24
Rated H.P. by makers.....	150	100	76	50
Developed H.P. in test, assuming 30 pounds of water from and at 212° per H.P.....	148·27	101·89	147·04	63·49
Water heating surface in square feet.....	1440	948·54	841	663·31
Steam heating surface in square feet.....	360	348·96	2·50	136·31
Total heating surface in square feet.....	1800	1297·5	843·50	799·62
Grate surface in square feet	50	35·13	31·41	21
Ratio of grate to heating surface	1:36	1:37	1:26·8	1:38
Height of chimney, in feet, from grate.....	44·5	44·5	28·6	44·5
Average steam pressure in pounds per square inch	91·41	95·83	83·54	98·71
Barometer in inches	30·323	30·253	30·299	30·274
TEMPERATURE, FAHR.				
Average temperature of the air (Fahr.)	57	57·84	50·26	45·25
Average temperature of the steam in boilers.....	341·32	337·16	326·19	343·78
Temperature corresponding to average boiler pressure	331·95	334·93	326·36	336·83
Average temperature of the chimney	369·92	411·03	422·72	346·85
Average temperature of the feed water	71·6	68·77	67·17	59·91
COAL AND ASHES.				
Pounds of wood used	291·5	348·5	232·5	191·5
Pounds of coal used.....	18021·5	11725·75	20026·5	6031
Pounds of coal and wood, including value of latter	18091·5	11809·39	20082·3	6076·96
Pounds of ashes	2666·75	1475·75	5048·37	654·25
Pounds of carbon.....	15350·64	9801·79	16808·8	5533·07
Pounds of carbon per hour	426·41	272·27	466·9	230·54
Pounds of coal per hour...	468·87	328·04	557·84	253·21
WATER.				
Pounds of water fed in the boiler at average temperature above given ...	134937·3	92606·75	137152·75	38108
Pounds of water evaporated per hour from and at 212°.....	4448	3056·79	4411·21	1587·83
Pounds of water evaporated per pound of coal	7·99	7·84	6·75	6·27
Pounds of water evaporated per pound of carbon from and at 212° ...	40·43	11·23	9·45	8·26
Quality of steam by thermometer or amount of superheating	9·37	2·23	.....	6·95
Percentage of moisture ...	.....	.....	1·55	.....
RATE OF COMBUSTION.				
Pounds of coal burnt per square foot of grate per hour	10	9·3	18	12
Pounds of water per square foot of grate per hour...	87	89	140	76
Pounds of water per square foot of heating surface per hour.....	2·3	2·5	5·2	2
DRAFT.	Blower.	Natural.	Steam jet.	Natural.
Mean draft in chimney in inches.....	·07	·24	9·15	·43
Steam room in boiler in cubic feet	7·65 ap.	29·8	67	.....

The *American Engineer* thinks authentic results and addition to the science of steam engineering have not been the outcome of these trials. Still the results are interesting, and Mr. Spangler is entitled to credit for doing the best he could under the circumstances.

MACHINES WITH AUTOMATIC REGULATION.

M. DE MERITENS has recently presented to the International Society of Electricians a new system for regulating the current of machines. Of this system simplicity is not the principal merit, writes M. Hospitalier in *L'Electricien*, if we may judge by the fact that in the instance selected by the inventor, with 100 glow lamps of 50 volts and 1 ampère forming 10 distinct and connected groups of 10 lamps each, there are needed no fewer than 21 electro-magnets to keep up a constant potential, whatever may be the number of lamps burning at each instant.

The principle of the arrangement devised by M. de Meritens consists in employing a machine excited in derivation, in fitting the 10 groups of lamps in 10 distinct circuits with a common return, and in introducing an electro-magnet into each group. Whenever a group of lamps is kindled, the corresponding electro-magnet comes into play to reduce suitably an auxiliary resistance introduced into the circuit of excitation, but in place of acting directly these electro-magnets serve only as relays for ten other electro-magnets, which raises to *twenty* the total number of contacts to be kept in good order, so as to secure the action of the system. The twenty-first electro-magnet is connected with the kindling, but its function is not explained in the note which we are analysing.

M. de Meritens points out that this system, which works with a mathematical regularity, may easily be extended to the regulation of lamps grouped in fives, which would raise the number of electro-magnets required to *forty-one*.

Some years ago systems of regulation might be sought for in the order of ideas indicated by M. de Meritens. At present the result can be reached much more easily, especially with so low a potential :—

1. By shunt dynamos with a very small internal resistance.

2. By machines with double excitation, as shown in 1881 by M. Marcel Deprez.

3. By Captain Cardew's coiling, which consists in exciting the machine and wrapping the inductors with 10 parallel wires, each corresponding to a circuit of 10 lamps, which proportions the excitement to the consumption without auxiliary apparatus.

PRIVATE INSTALLATIONS OF ELECTRIC LIGHTING.

IN his paper descriptive of a private installation of electric lighting, read, as we noted last week, before the Institution of Mechanical Engineers, Mr. RALPH H. C. NEVILE, of Wellingore, dealt specially with an installation at his own house, this installation consisting of 125 incandescent lamps distributed over some 50 rooms and offices. The motive power used was a 6 horse-power portable engine, some ten years old, which Mr. Nevile had been using for pumping and driving a saw, and which was fitted with an old-fashioned governor. Naturally this engine gave trouble when employed for electric lighting, and the description of the manner in which its defects have been overcome by the application of Mr. Richardson's electric regulator, with some special modification devised by Mr. Nevile himself, constituted the most interesting feature of the paper, and led to the chief discussion. *Engineering* gives some of the main features of Mr. Nevile's paper, which will enable the subsequent discussion to be understood.

In Mr. Richardson's electric regulator the throttle valve is a double-beat valve the position of which is controlled by the cores of a double solenoid arranged on a shunt circuit between the main leads, the arrangement being such that an increase of the electromotive force causes the throttle valve to be partially closed and the speed of the engine reduced, and *vice versa*. This apparatus when applied to Mr. Nevile's engine effected a great improvement, but the regularity of current was still not all that was desired, and Mr. Nevile accordingly devised certain additions which, as ultimately arranged, consisted of two small cylinders connected to the boiler and valve chest respectively, the pistons of these cylinders pressing against the lever by which the throttle valve was actuated, but on opposite sides of the fulcrum of that lever, the result being that a rise of pressure in the boiler tended to assist the closing of the throttle valve by the solenoid, while a rise of pressure in the valve chest had an opposite effect. The cylinders were adjustable to different distances from the fulcrum

so that their relative effect could be varied. Mr. Nevile also stated that in the case of an engine driving any other work, and when it was desired to vary its speed from a distance, the governing arrangement described might be turned to account by causing the engine to drive a small dynamo furnishing electricity for the regulator. The electromotive force in the mains would then furnish at any point a measure of the speed of the engine, and by means of a switch and a set of resistance coils the speed could be altered as desired. Speaking after the reading of his paper, Mr. Nevile remarked that he had had experience with this arrangement when his engine driver was away for a holiday, during which time he had practically driven his engine from his house, a carpenter being merely employed to oil the machinery and keep up steam.

The discussion on Mr. Nevile's paper was opened by Mr. R. E. CROMPTON, who expressed his doubts as to certain experimental results given. He (Mr. Crompton) had experimented with electrical governors for some years past, and he had come to the conclusion that electric force alone, although apparently a powerful agent, was not practicably applicable on account of the resistances to be overcome in working a controlling arrangement. He had found from experiment that throttle-valve spindles, even if small, could, by improper packing, be made to oppose a resistance of from 30 lbs. to 40 lbs. to movement, and he considered that in the arrangement described the solenoid could not exert sufficient pull (under a moderate alteration of electromotive force) to form a trustworthy agent for actuating a throttle valve. The proper way of operating was, he considered, to use the solenoid to operate the slide valve of a steam or hydraulic cylinder by the movement of the piston of which the throttle valve was in its turn operated. There had been several experimenters working in this direction, and Mr. Willans had been particularly successful with his governor acting on this principle. He (Mr. Crompton) had applied many of these governors, and in none was the pull provided for less than 30 lbs., while it was sometimes 60 lbs., and in one case where the controlling gear of a turbine had to be operated it amounted to one ton. This great regulating power could be afforded by an apparatus no more complicated and no more costly than that described in Mr. Nevile's paper. It was also desirable to use a small current in an electric regulator, and thus avoid waste. In the arrangement described he considered that the real work of governing was performed by the two auxiliary steam cylinders, the arrangement of which practically constituted a reducing valve, the solenoid being left comparatively little to do.

Mr. TIMMIS, who spoke next, differed from Mr. Crompton. remarking that using a small current of high electromotive force was the same as using a large current with low electromotive force. With regard to Ayrton and Perry's spring ammeter referred to by Mr. Nevile, he observed that before long he hoped to be able to give particulars of a new ammeter, which would not only measure current, but also act as an electric governor. He (Mr. Timmis) had also great faith in the future of accumulators; he had been using the Sellon-Volckmar cells in various parts of the country, and was more than satisfied with them.

The next speaker was Mr. SYDNEY F. WALKER, who regarded Mr. Richardson's governor as more simple than that of Mr. Willans. He considered that a distinction should be drawn between large public installations for electric lighting and a small private installation. In the former the employment of some complication was quite permissible to secure economy, while in the latter great simplicity was especially desirable. As for ordinary mechanical governors, none of them would satisfy the conditions of providing for a greater speed of engine with an increased load and a reduced speed with a reduced load; but this was what was required for electric lighting work, and an electric regulator would supply it.

Mr. DRUITT HALPIN considered that the system on which Mr. Willans' electric governor operated was the correct one, namely, that the hard work of moving the throttle valve or its equivalent should be done by a steam or hydraulic cylinder or other convenient source of power, and that the electric governor itself should merely "do the thinking" or direct this power. He also referred to an arrangement recently introduced in which the actuating power was water drawn from the boiler. The electric governor was a valuable arrangement for giving a variable speed in proportion to the electromotive force required, as had been explained in the paper, but when a constant speed was required it could be perfectly attained by mechanical means. As an instance of this, he mentioned a tandem compound engine by Messrs. Hicks, Hargreaves & Co., which had been put down at Temesvar for electric lighting purposes, in which the speed was so well controlled by the Knowles supplementary governor employed, that the variation of speed due to a reduction of load from 200 to 100 horse-power amounted to but one-third of 1 per cent., as shown by a Moscrop recorder. Under these favourable conditions of driving, the lamps had already lasted from 2,000 to 2,100 hours.

Mr. FAIRFIELD, who spoke next, observed that he had had considerable experience in installations in which the engine employed for driving the dynamos had also to drive other machinery, particularly at lace work. The load on an engine at a lace factory was more irregular even than that of an engine working a rolling mill, frequently varying from 100 to 18 horse-power in less than a minute. Under these conditions he had found it quite possible to insure that the variation of speed as shown by a Moscrop recorder should not exceed 1 per cent. Messrs. D. Adamson & Co. were now making an engine to vary in speed not more than ¼ per cent. under such conditions. When a constant speed of driving could be insured, a constant electromotive force could be obtained by a suitable compound wound dynamo, and he believed that Mr. Crompton was quite ready to supply compound dynamos which would give the required steadiness of current under such conditions. It would, he considered, be found that the electric light was likely to be most largely applied at places where surplus power already existed, and these conditions must be met. What was required was a governor which would control the electromotive force by shifting the commutator brushes, or by altering the shunt coil.

Sir JAMES DOUGLASS regretted that Mr. Nevile's paper referred only to incandescent lighting. For mechanical engineers generally he considered that arc lights had the greatest interest, as they were the only lights suitable for factories. Incandescent lighting could at present barely hold its own with gas, while with arc lights the illumination afforded by a given consumption of coal was fully four times as great as would be derived from the combustion of the gas which could be produced from such coal. His experience showed that there had been a vast improvement in arc lighting during the past few years, and notably in the quality of the carbons supplied. No electric light engine, he considered, could be efficiently controlled without an electric governor, but electricity could be used for this purpose without involving loss of power. The manner in which the carbons were regulated in the lamps of Serrin, Dubosc, &c., showed this.

This remark induced Mr. E. B. MARTEN to ask how much power was really absorbed by the electric governor, which had been described in the paper, while Mr. D. Greig asked Mr. Richardson as to the relative economy of engines with cylinders above and below the boiler, and also whether the cylinders of the underneath engine were steam-jacketted, and if so, whether the fact of the water from these jackets going to waste instead of draining back into the boiler, as in engines, with cylinders above, was found to cause a loss of economy.

The next speaker was Mr. P. W. Willans, who, referring to a statement made in Mr. Nevile's paper, that one advantage of an electric governor was, that it would increase the speed of the engine if the belt slipped, observed that he considered this a disadvantage. It was well known that if a belt started slipping, it was likely to continue; and if the speed of the engine was increased to compensate for this slip, the belt would probably be thrown off. Sir James Douglass's suggestion for governing, he considered, amounted to the employment of a relay, such as he himself advocated in one form or another.

The last speaker in this discussion was Mr. L. STERNE, who observed that he must make a protest against a statement in Mr. Nevile's paper, that the use of a gas engine for electric lighting purposes caused a "bobbing" of the lights. This was not the case if the engine was made to give an ignition every revolution; and perfectly steady electric lighting could be obtained by such an engine.

Mr JOHN RICHARDSON, in replying on the discussion, said, in answer to Mr. Greig, that there was no gain in economy by placing the cylinders under the boilers, but a great gain in stability. With regard to Mr. Crompton's remarks he stated that he (Mr. Richardson) could manage to get throttle-valve spindles so packed as never to require a heavy force to move them; in fact the valve in the governor described, closed by its own weight. In arc lighting there was no loss from the employment of the governor, the working current passing round the solenoids. In the arrangement described three different things had to be compensated for, viz., varying pressures in the boiler, varying presure in the valve chest, and variation in the electromotive force; and the two former were practically compensated for by the auxiliary steam cylinders, leaving the last-named variation to be dealt with by the solenoids.

Mr. NEVILE also replied to the discussion. Commenting on the remarks of Mr. Crompton, he observed that he should not like to apply the governor described to actuate a throttle valve which required 30 lbs. to move it; but this was unnecessary, as the valve employed fell by its own weight, which was about 11 ozs. As regarded the relay system of governing, it is quite as likely to go wrong as the other system. With regard to the power absorbed by the governor, he stated that such a governor as that exhibited, which was suitable for an engine driving 300 lights, required 1·8, or say, 2 ampères, or less than 1 per cent. of the whole current required for the work done. He had not dealt with arc lighting in his paper because the latter related to private installations for which arc lights were not suitable. As to Mr. Willan's remarks on the slipping of belts, he (Mr. Nevile) considered that these belts always did slip to some extent, and it was with such small slippings that the governor could usefully deal and compensate for; slipping of dangerous amount must be dealt with by the engine driver. As for gas engines, he had said that they "generally," not always, caused bobbing of the lights; at all events, he had not come across any the driving of which satisfied him. Even with double cylinder gas engines giving an impulse every revolution, the conditions were only one-fourth as favourable as in a double cylinder steam engine which would give four impulses per revolution. Moreover, in the gas engine the one impulse per revolution only existed when the engine was working at full power; with a reduced load the impulses were at longer intervals. He believed that some attempts were being made to regulate gas engines in the same manner as steam engines, but he had come across none so regulated.

Mr. STERNE explained that an engine so governed had been made by his firm, and that it was being employed by Prof. Thomson, giving steady driving either with one lamp or sixty.

The Reverend Precentor, EDMUND VENABLES, M.A., here rose to observe that the large attendance at the cathedral the previous

evening showed the desirability of lighting the nave by electricity and he considered that the present was a very suitable occasion for inaugurating such an innovation. Under such circumstances he would be glad if some of the engineers present would favour him with advice on the subject; an observation which led the President to remark that the reverend precentor might expect to be overrun with the visits of electric light engineers in the course of the ensuing week. A cordial vote of thanks was then, on the motion of the President, accorded to Mr. Richardson and Mr. Nevile for their respective papers.

THE INVENTIONS EXHIBITION.

(1339) The Globe Electrical and Engineering Company of 20, Dartmouth Street, Westminster, has almost a complete display of Mr. Killingworth Hedges's inventions. We have already described his fusible cut-outs, which are of the same pattern as exhibited at the Philadelphia Exhibition last year. We now illustrate a new form of automatic cut-out, fig. 1 and 2, which is simply a weighted lever which is released by a tripping gear actuated by an electro-magnet in shunt circuit. The main current enters at F, passes through C, and leaves at F¹. A small

FIG. 1.

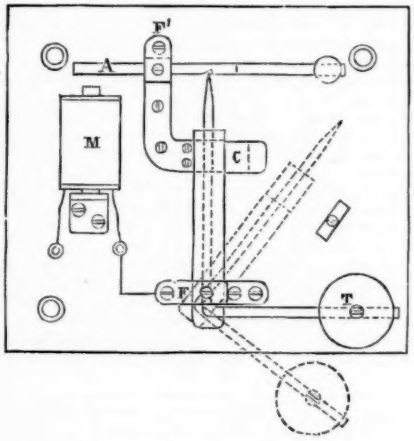
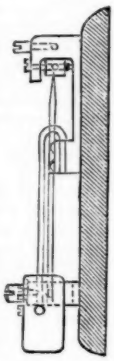


FIG. 2.



portion is diverted at F through the high resistance magnet, M, which is connected to some part of the line which would give such a difference of potential as to allow ½-ampère to flow through its coils. Directly the current in the main circuit exceeds a certain amount, the excess which passed through the shunt, M, attracts the armature, A, releases the tripping lever, T, and thus allows the contact piece, C, to be quickly withdrawn;

FIG. 5.

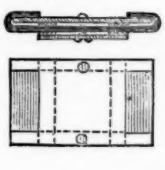
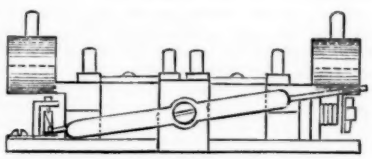


FIG. 4.



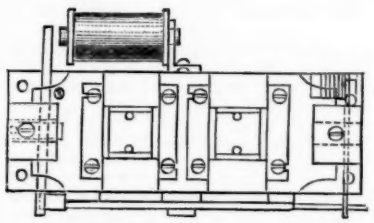


FIG. 3.

this opens the main circuit, which cannot be re-established until the current flowing through M is reduced. This plan has an advantage over a kind introduced by other manufacturers in that the electro-magnet being placed in shunt circuit, a trifling amount of current which never exceeds in practice about half an ampère is enough to put in action the tripping gear, and thus any number of lamps are controlled, while only a given number of lights are protected by the instrument with the magnet in series, according to the gauge of wire used in winding the coils. The same arrangement is also exhibited applied to a duplex cut-out, in which it automatically inserts a spare mica foil for that fused (*Vide* figs. 3 and 4). The Hedges fuses or mica foils exhibited show a marked improvement on the original design, in which they were too delicate, and sometimes gave way by being roughly handled. They are now made

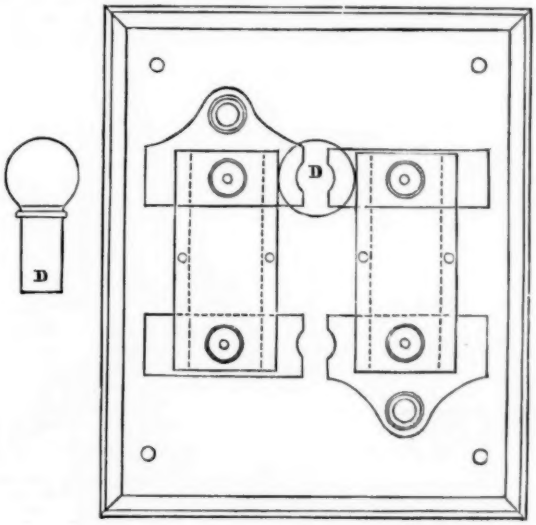


FIG. 6.

as illustrated in fig. 5, which shows a plan and end view. The foil, coloured black, composed of pure tin for the small currents, and albo metal (an alloy of aluminium and tin) for the large, is held between pieces of mica, which allow for its expansion when heated; one piece of mica passing under the contact piece serves to stiffen the foil and protects it from rough usage. Another simple pattern of cut-out is shown by fig. 6. The mica foils have eyelets, through which a binding screw passes. This arrangement, which admits of a spare fuse being quickly substituted for that melted by changing the plug, D, was specially designed for Mr. W. H. Preece, who has used it in his own house for some time, and recommended it strongly in his paper read before the Society of Arts last year.

(1356) Messrs. Thompson, Dowsing & Rew, of 4, Queen Victoria Street, E.C., exhibit carbons made according to M. Carré's plan, the chief points in which they excel being the extreme steadiness of the light, surpassing in this respect many of the more expensive sorts of carbons now before the public, the purity of the light which renders them most fitted for matching colours, and the freedom from ash. This firm is the only one in England which supplies Carré's improved carbons, which are admitted to be much better than the older make by those who have tried both sorts. Some of the belting shown on the stand is made of leather treated in a peculiar manner, and known as "orange tan leather." This process of tanning has many advantages over the usual manner of preparing leather, as hide when thus prepared does not expand so much as that which is tanned in the ordinary manner, and becomes more pliable. These belts run very straight, and transmit very high powers. Link belting, made of orange and oak tanned leather, is found most useful when the distance between centres is short, as the grip is good. It is most simple to shorten or lengthen belts of this description, and thus they save much trouble and expense. All the belts shown are specially adapted for high speeds, such as are necessary for dynamos. In the accumulators shown here, the chief feature is that the lead is made porous by a crystalising process during manufacture. Usually the making of the plates porous takes a long time and is expensive, but both time and expense are said to be considerably reduced by Mr. Howell's method. This process also obviates the necessity of putting any extraneous oxide on the plates. Dynamo machines are also exhibited of the Gramme type, the only difference being that the armature is wound in sections for facilitating repairs. Great care and attention has been paid to the finish and details of these dynamos. Terminals, screws, and electrical fittings of all sorts, such as bells, switches, lamps, &c., are shown, in which cheapness, combined with efficiency, has been the great point aimed at.

(480, Group IV., South Gallery, Middle Court.)—High-speed friction driving gear, Ewing and Jenkin's patent, 1884. The illustration shows an arrangement of mechanism for the transmission of power by rolling contact, the subject of a joint patent by Prof. Ewing, of University College, Dundee, and the late Prof. Fleeming Jenkin, F.R.S. This gear is specially applicable to cases in which power has to be transmitted from a low speed to a high speed shaft, or *vice versâ*, as in the driving of dynamos, fans, saws, grinding wheels, the cutters of wood-working machinery, &c., and also in taking power from a high speed electric motor. It forms what may be called a multiplying coupling between the high speed and low speed shafts. In the illustration, A is the low

speed and B the high speed shaft; the former carries a large drum, *a*, and the latter a small drum, *b*. Between them are two intermediate shafts, *c*, *c*, each of which has keyed on it two drums, *c* and *d*, which roll on *a* and *b* respectively. The pressure between the drums, which is necessary to allow them to transmit power by mere frictional contact, is provided by a continuous multiple band which runs on grooved pulleys, *e*, *e*, on the intermediate shafts, and is kept tight by passing over the hanging sheave, *f*. which also serves to guide the band diagonally across from one side to the other of the grooved pulleys. The hanging sheave, *f*, is pulled by a weight or spring, so as to maintain enough stress in

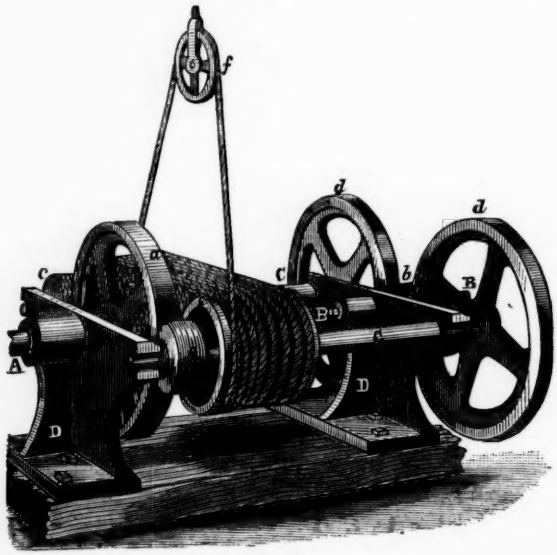


FIG. 7.

the band to prevent the friction drums from slipping. The numerous plies of the band serve to press the intermediate shafts towards the line of centres with moderately great force, and the grooved pulleys are so situated between *a* and *b*, comparatively near to *a*, that this force is properly distributed between those two rollers. The intermediate shafts turn in slot guides or have sliding bushes, which enable them to approach the line of centres. It should be noticed that the pressure necessary for frictional gearing is produced without causing disadvantageous friction at the journals; the principal forces are in fact balanced, so that wear and friction are reduced to a minimum. In this respect the novel mechanism now exhibited has a great advantage over friction gears in which the shafts are pressed together by forces applied through bushes in which they turn. In the example shown, the small rollers are made of compressed paper, and the large ones of cast iron—a combination which is found to be nearly noiseless, and to run very well. The shafts, A and B, are shown carried in different standards, D, D, which also furnish slot guides for the intermediate shafts. The bearings of A and B may, however, be entirely distinct from the rest of the mechanism, as where A is the overhanging end of the crank shaft of a steam engine, or B that of the armature of a dynamo. In the model shown in the Exhibition, there are fast and loose pulleys on shaft A to facilitate disengagement. Instead of only two intermediate shafts, three or a larger number may be used, symmetrically disposed round the line of centres. A small model of a form of the gear with three intermediate shafts is shown in the Exhibition, as well as a larger model with two shafts. In addition to its high efficiency (or small loss of power in transmission), the gear has the advantage of giving great multiplication or reduction of speed in a very limited space. In the example shown the ratio of velocities between the driving and following shafts is about one to twenty. The drawings exhibited show types of the gear suited for the transmission of from ten to fifteen horse power.

(1407) The Jablochkoff and General Electricity Company have shown considerable taste in the arrangement of the contents of their handsome show-case. Samples of their alternate current machine, of the Jablochkoff candle and its component parts, and of the candle holder with candles fixed, are supplemented by fittings of a more ornamental nature, such as arc lamps in handsome brass harp frames, and brass fittings for incandescent lamps. The object of the exhibit seems to be to show that while the motto of the company is "simplicity and economy," they are at the same time quite prepared to carry out work with due regard to the requirements of artistic decoration.

(1391) Prof. Crookes has put into very small compass one of the most interesting exhibits in the group, and one that must have occupied much time and attention. Among many other things may be mentioned an illustration of the ten stages through which an incandescent lamp passes from the piece of glass tube to the complete lamp. There is also a set of lamps from 1 up to 20-candle-power; filaments produced from various materials under different modes of treatment; samples of the smallest lamps ever made; a modified bridge for taking the resistance of carbon filaments whilst in a state of incandescence; platino-copper wire, that is, copper wire covered with a sheath of platinum, for incandescent lamps.

(1680) The exhibit of the India Rubber, Gutta Percha and Telegraph Works Company is in the East Quadrant, and consists of samples of raw gutta percha and India rubber from the various sources of supply, and illustrations of the mode of treating these materials for a great many different purposes. The covering of single wires is shown and the way of making joints, as well as the constitution of torpedo cables and grappling ropes. Sections of the following cables, all of which were made and laid by the company, form quite a handsome trophy:—Havana—Key West, 1867; Marseilles—Algiers, 1871; Dublin—Holyhead, 1871; Lizard—Bilbao, 1872; Marseilles—Barcelona, 1874; Peru—Chili, 1875-6; Marseilles—Algiers, 1879-80; Gulf of St. Lawrence, 1880; Central and South America, 1881-2; Cadiz—Teneriffe—Senegal, 1883-4; Dublin—Holyhead, 1884.

Japan.—In the Japanese court there is a very interesting exhibit, consisting of a glass case containing specimens of electrical manufactures, most of which are contributed by the Japanese Imperial Telegraph Department. There are lacquered paper vases or cells made of 50 layers of paper, adapted for holding chemical solutions and for electrical purposes, possessing the two qualities of lightness and strength; also porcelain insulators and battery jars, complete batteries and wooden battery boxes. Samples are shown of lacquered copper wire which was first introduced by the exhibitor in 1880. The wire is coated with lacquer and dried at a temperature of 150° F. The surface of the wire is reduced to a minimum, and there is no fear of the escape of electricity even when the wire is wet. A less quantity of silk thread is required for covering this wire than for other kinds. There are also various specimens of silk-covered wire, a field sounder and batteries, a voltmeter, an ampèremeter, a tangent galvanometer, two Morse instruments, lightning dischargers, telephones, and a central station switch board. These are all remarkable for that conscientious perfection of detail and honest workmanship which are the characteristic features of all Japanese productions, and therefore well worth the inspection of those who take an interest in electrical instrument making.

Belting.—The main driving bands in the Electric Light Department have been supplied by Messrs. John White and Sons, of Bingley, a firm well known throughout the manufacturing centres of this country, as well as on the continent and in the colonies. The bands are fine specimens, both of double and treble leather, and have yielded the most satisfactory results, transmitting considerably over the maximum of indicated horse power without apparent injury. In fact, they run with a smoothness and noiselessness rarely observable. At stand 555, in the central avenue, which adjoins the electric light offices, are shown samples of other specialities in the way of belting, including Messrs. White and Sons' patent triangular and square leather ropes, and a new adaptation of textile material combined with leather, and termed "duplex" belting, recommended for its efficiency and cheapness in light driving and high speeds. The triangular leather rope may be seen driving the Thomson-Houston dynamo, in the electric light shed.

Scientific Apparatus.—A revised catalogue has been recently issued by Messrs. Harvey and Peak, of Beak Street, Regent Street, giving descriptions and prices of a large number of instruments, apparatus and materials, for the demonstration of the facts and laws of science in its various departments. The excellence of the work executed by this firm has recently secured for them the appointment of makers to the Royal Institution of Great Britain.

Electric Light Fittings.—Messrs. Faraday and Son, of Berners Street, have just printed a new issue of designs of their electric light fittings, consisting of electroliers, brackets, standards, pendants, sconces, lanterns, and other forms principally for domestic requirements. The drawings number in all about sixty, and display considerable diversity of treatment.

IMPORTANT TELEPHONE PATENT CASE.

(*Specially reported for the* ELECTRICAL REVIEW.)

HIGH COURT OF JUSTICE.—CHANCERY DIVISION.

(*Before* MR. JUSTICE NORTH.)

UNITED TELEPHONE COMPANY, LIMITED, V. BASSANO AND SLATER.

(*Continued from page* 124.)

The ATTORNEY-GENERAL, replying for the plaintiffs, after paying a well-deserved compliment to Mr. Claud Plumptre, for the way in which he had conducted the defendants' case under serious difficulties, said he could not regard the issues in this case as involving any very great difficulty now that the evidence was wholly completed. He submitted that the decision was to be defined on certain broad lines and broad principles which were clearly brought out by the examination of the witnesses, and that it was not a case in which the decision depended upon any narrow and technical rules: but whether the decision was to be for the plaintiffs or for the defendants it would be by regarding what was

the effect of the evidence upon certain broad and leading lines. He mentioned in the early part of his opening a matter which he ventured to think might be of some little importance in connection with the real defence of the case. This action being commenced upon the 29th May, 1884, the original defence was delivered on the 21st August, 1884. In that defence the only particulars of objections which were delivered were particulars of objections with respect to the question of infringement solely; the defence was simply a denial of the infringement, and so the matter rested. Within a few days of the case coming on for trial, in fact counsel had been instructed to apply for a day for the hearing, on the 2nd of April, 1885, an amended defence was delivered, and in that amended defence no less than nineteen or twenty alleged anticipations of the plaintiffs' patent were set up. He took the responsibility of saying in his opening that he should not address his lordship upon the alleged anticipations, because the whole of them had been practically dealt with by Mr. Justice Fry, and because there was nothing new. He thought his lordship must have been struck by the fact that there was, practically speaking, no cross-examination whatever upon any one of those anticipations. They had not been referred to by a single witness for the defence, and with the fairness which had characterised the conduct of the case by the counsel appearing for the defendants, his lordship had not heard one word attacking the validity of Mr. Edison's patent. He referred to this at the very opening of his remarks for this reason. The attempt made by the defendants now was to put upon Mr. Edison's specification a most narrow and limited construction. It was sought to confine this specification to a special combination of a special kind of diaphragm with a particular form or forms of tension regulator. If there had been any anticipation of Mr. Edison's invention it would have been in the highest degree important to the defendants in their endeavours to support the proposition that Mr. Edison's specification was to be narrowed to those lines to have showed that persons prior to the month of July, 1877, had told the world, at any rate something like that which Mr. Edison told it, so as to really say, "You are seeking to construe your specification to include something which is not fairly within it." They had considerable experience in that case of the way in which existing knowledge was used in order fairly—and only fairly—to narrow the construction to be put on the plaintiffs' specification. As Lord Blackburn had often pointedly put it in the House of Lords, if your patent is to be construed to include this particular combination it is bad, because we show you that practically that combination existed before, therefore you must have a more narrow construction put upon your patent. He asked his lordship to remember the particular fact on which the whole case depended; this specification of Edison's came upon the world as a complete revelation, which absolutely started knowledge afresh; more strange still, this starting point gave life to the fossil bones which had been laid by in the cupboards of the electrical men of science, believing that they had gone to the extremity in the direction in which science was then taken. The view he would show on the face of the specification had been adopted by Lord Justice Fry and by the Scotch Court as the correct view, namely, that Mr. Edison did by his research either discover new functions, or if he did not actually discover functions, described the adaptation of the old functions in a new way, which had the effect of revolutionising the world of science on that particular matter. He would not suggest that Mr. Edison contemplated this or that particular kind of infringement and guarded against it by words in his specification, because that would not be reasonable, it would not be natural; it was very seldom that such a thing took place. But they had this, which he humbly submitted was the correct and proper way of specifying such a matter according to the law of England as it now stood, that having discovered a new mode of manufacture—he rejected the word principle because it had given rise to a great deal of misunderstanding, although it was used in the old cases—having discovered a new mode of manufacture, he enunciated what were the essential conditions of that new mode of manufacture; he described the very best way in which that new mode of manufacture could be carried into effect; and he respectfully asserted as his argument that, given these premises, no man could make a combination which involved the same fundamental operations, however differently attempted, without infringing the plaintiffs' patent, which was admitted to be valid. The task he had set himself to perform in connection with this case was this, to show his lordship by a careful, but he hoped not too lengthy, examination of the evidence, that there was no doubt in the mind of any single witness, on the one side or the other, as to what the necessary operations of the various parts were, and there was no dispute as to what the functions performed by the parts of the instrument were. There was not the slightest doubt, either, that to a greater or less extent the defendants' infringement performed those functions, and did nothing else. You never did find a thing looking like a patented article; if the thing looked like it the defendant would not be able to contend for a moment that it was not an infringement. The common difficulty put upon courts in these cases was to make the thing as unlike the specified article as possible, and the duty of the court was to strip away the surroundings, that which would mislead the eye, and to get to the real kernel of the matter, and see what the defendant had really done. Later on he would have to show how the effect of the so-called experiments told distinctly in favour of the plaintiffs' view; but he did at once respectfully urge as his argument that the view only incidentally thrown out by his lordship, that he regarded experiments as merely a means to inform his mind, was the correct view. It was pointed out by the late Sir George Jessel, Master of the Rolls, in the course of the last telephone case, that that only could be the function of experiments. Otherwise the determination of the case might depend upon the particularly acute sense of hearing or of smell of the particular judge. His lordship had not to try whether the experiment was an infringement, but whether this particular thing which the defendant was doing was an infringement. At any rate there was the very highest ground for believing that those experiments were successful in so far as they involved the same functions as the patentee had described, and they were unsuccessful because they abandoned or disregarded the particular things which the patentee had pointed out as being, if not essential, useful or particular points of his invention, or because they had used inferior forms of that of which the patentee disclosed the very best forms. He asserted that every single witness had admitted that, whether it was called diaphragm, or tympan, or contrivance, or whatever name was given to it, the sole function of the apparatus, the first part of it, was to intercept the sound waves, and to utilise the interception by action upon the electrical circuit. He would read the answers given by Prof. Forbes, the principal witness of the defendants, to two questions which he (the Attorney-General) had put. "Except the taking up of the sound waves and with them acting upon the tension regulator, is there in this specification a single function of the diaphragm described?—To the best of my knowledge, no." "I put it to you as a person of great scientific knowledge, taking any form, speaking as a class, is not that the only function which, as a fact, the diaphragm performs?—I think so." The defendants were not, of course, bound by Prof. Forbes's answer, except that it was the scientific statement of their best witness. If Mr. Plumptre had been able to show that these were not the functions of the diaphragm, on the face of the specification, he was perfectly entitled to do so. He would ask his lordship to follow a few passages in the specification. The first of importance was on page 4, line 8. "This invention relates to that class of electrical instruments in which sound becomes one of the elements in the transmission of the communication, and the same sound is produced at the receiving station." At line 19 on the same page: "In my present invention I make use of the vibrations given to a diaphragm or tympan, by speaking into a resonant case, to produce a rise and fall of electrical tension upon the line with such accuracy that the electric pulsations or waves will represent the atmospheric sound waves produced by articulation." At line 27, "The resonant tube or box, *a*, is of a size or shape adapted to being spoken into, the same having an opening at one end or side, and a diaphragm or diaphragms, *b*, against which the sound waves from the human voice act, and these and the motion that the diaphragm receives, is the means of producing a rise and fall of electric tension on the line by the devices hereafter set forth." Line 36 is to the same effect: "The general features thus described pervade my entire invention, but in developing the same many useful and important modifications and variations have been made." Was it to be contended for a single moment that, if he was correct in saying that these sound waves produced articulation by varying the resistance, and operating upon the tension regulator, as described, that it was a new method, was it to be said that because Mr. Edison did not describe the particular mode and modification in which these same functions were put into operation it was outside the specification? He challenged his learned friend even now to bring forward even the slightest authority for that. The patentee had shown the best way, which would guide the public to the proper use of his invention. In line 46 in the same page: "In some of the modifications I have shown the speaking instrument as a fixture, and also the hearing instrument as a fixed resonant tube, these being variable to suit the persons or the places." Line 54: "By providing an edge in the resonant tube below the mouth, upon which such consonant sounds are received, the vibrations are given either to the resonant tube or deflected to the diaphragm." There the resonant tube would act as a means of giving effect to the vibrations transmitted by the voice. There was not really one of these made. Edison only used it for the purpose of showing that he regarded the resonant tube as something which assisted the vibrations. "I find it preferable to employ a hole, *e*, at the lower part of the mouthpiece, against the edges of which the downward sound waves are directed." The importance of that, from the plaintiffs' point of view, was that Mr. Edison was only pointing out different ways in which you might construct a mouthpiece and resonant case, so as to intensify the vibrations of that case under particular circumstances, acting instead of a diaphragm in some cases, differing in other cases, but the whole point being that the sound waves of the human voice are so to operate as to produce the rise and fall of electrical tension upon the tension regulator, which is afterwards going to be described.

MR. JUSTICE NORTH: Do you suggest that any instruments were made without any diaphragm at all?

The ATTORNEY-GENERAL: No, my lord. If an instrument were made which did not in any way by mechanical means perform the functions of a diaphragm there would be no infringment. Professor Forbes came into the box meaning to tell what was in his mind, and not to keep anything back; but by his great care to narrow Mr. Edison's invention to what he then believed it was he had absolutely lost sight of two or three most important passages in the specification. He first said the diaphragm must be between the speaker and the regulator, and then that there must be complete separation of the whole passage, and in his evidence-in-chief those were considered most important passages.

MR. JUSTICE NORTH: I thought he said it might be on both sides.

The ATTORNEY-GENERAL: Not until your lordship called his attention to it. He then admitted that according to his reading it might be on either side. In the same way the diaphragm had been spoken of as a continuous sheet to divide one part from another. That was why he read this: "I sometimes perforate the tension regulator and place a piece of elastic material across said diaphragm over the hole, and upon this a piece of foil, so that the same responds to very weak vibrations, and in some instances two or more diaphragms are provided at different sides of the resonant box, each with its own tension regulator." The answer given by Professor Forbes, that the diaphragm should separate the instrument into two parts and be placed in the passage, was inconsistent with the view that a person should have diaphragms at the sides of the box as well as at the end, which diaphragms were there for the same functions, intercepting the sound waves and carrying them to the tension regulator. But there was a passage in the specification which absolutely disposed of the contention that Edison meant this limited construction of the diaphragm, and nothing else: "A plate supported excentrically and free at its edges when placed in the speaking tube responds advantageously to the tones of the voice." Striving from their point of view, not at all unfairly, to do their best to narrow the construction of Mr. Edison's specification, both Professor Forbes and Mr. Conrad Cooke said that in their judgment Edison's diaphragm must be fastened round its edges, that it must act centrally upon the tension regulator, and that there was intended to be contact between the tension regulator and the centre of the diaphragm. He submitted that it was absolutely impossible, in the face of that paragraph in the specification, to allege that Mr. Edison ever meant to confine his diaphragm or tympan to the special conditions which Professor Forbes endeavoured to put upon it. The conditions were, that it was completely to separate the one part of the instrument from the other—this did nothing of the kind; it was to be fastened centrically—this could not be, for it was to be fastened excentrically; the tension regulator was to be operated upon by the centre of the diaphragm—the specification said, in so many terms, it was to communicate with the edges of the diaphragm; the diaphragm was to be fastened round its edges, to complete the separation—this, in so many terms, said it was to be free at its edges. He did not ask for a benevolent construction, nor that the specification should be read widely, so as to include what it did not indicate; but he submitted that it was utterly impossible that while Edison was describing a class by its functions, he should be required to state every individual variation which it was possible to make. Having pointed out passages in the decision of Lord Justice Fry in the previous telephone case which he thought would assist his lordship, the Attorney-General submitted that he had proved, by the admissions of the defence and by the evidence of the plaintiffs' witnesses, that except in degree, the shape or form of the instrument which collects the vibrations and sends them forward is immaterial. Speaking of the experiments which had been spoken of in evidence, he said he was upon entirely different ground to what the defendants were. He was experimenting with the thing itself, that which was alleged to be an infringement; they were experimenting with some things which were different in form and substance, and attempting to argue back from that. According to the contention of the defendants they did not use that which had the functions of the diaphragm at all. If they did not establish that they must concede infringement. It would not do to say, "We need not use it." That had been said over and over again, and every judge had treated it in the same way—"Why do you use it?" He took the defendants' instrument, which he unhesitatingly said was a diaphragm in the Edisonian sense. The black instrument, which had a cone and a base, was put in connection with a lover's telephone, which acted solely by the vibrations of the wood; and that spoke perfectly. That and the red back were put in connection with the lover's telephone, again acting solely by vibrations, and that again acted perfectly. This, the defendants were asking them to believe, did not in effect vibrate to the voice as Edison's diaphragm did. How could it have spoken through the toy telephone, unless it had that operation? The toy telephone had no electricity, no tension regulator, no microphonic action, and could only act by the to-and-fro vibration. Professor Forbes admitted that that red back would be about the very best thing you could use as a diaphragm in order to speak through a toy telephone. Had his lordship a shadow of a doubt that the black base was a diaphragm? If it was not intended to get the vibrations of the piece of wood acting upon the tension regulator, why was it that that was extended out in the way it was, giving a flat piece of wood of some inch and half in diameter, upon which Prof. Forbes admitted the sound waves would impinge and would act? Why was that done if not to get the diaphragmatic effect?

Mr. JUSTICE NORTH: It is spread out to hold the pencils.

The ATTORNEY-GENERAL said he could show that that was not the case. Those pencils might have been put in a very different position. But they found, as a matter of fact, that the black base vibrated so remarkably that you could speak through it to a lover's telephone. The contention of these people was, "All we want is to blow direct upon the pencils." They said they did not want this diaphragmatic action at all. But it ought not to be said that they did not infringe because they did not want it. Let them give up using that part of their instrument which the plaintiffs alleged did act diaphragmatically; and what would be the result? They had placed this beyond doubt by an experiment which took place; and he did not in any way refer to it as being evidence in the case, but for the purpose of showing the important difference in the instrument where there was a sounding-board or diaphragm and where there was not. Two carbon transmitters were suspended in air in his lordship's room. This was the same experiment which Mr. Plumptre spoke of as not being a correct or a useful one. He did not care for one moment whether Mr. Plumptre was right or not about that. As long as those transmitters remained as they were, his lordship could hear absolutely nothing—perhaps a faint buzzing sound sometimes, but nothing in the least articulate. As the board was brought up underneath the transmitters, they first heard, when it was at a distance and did not operate properly, a crackling sound, and then as it was brought more near, speech more distinct and articulate. The board taken away, speech disappeared; brought back again, speech was restored. Seeing that, how could his lordship say for one moment that the board in the defendants' instrument had no beneficial operation. Prof. Forbes admitted that no doubt all three things assisted the operation of the interference with the sound waves and their being transmitted to the electric tension regulator. He wanted no more than that. He cared not what else Prof. Forbes got; he cared not whether he could possibly, under some particular state of circumstances, speak without the mouth-piece, without the black base, and without the red back. In this instrument he had them all. In this instrument they were all in such a position that they vibrated to the sound waves, and as long as they had that he submitted that they infringed. There was proof almost uncontradicted that the defendants' apparatus contained in it the first step in in the plaintiffs' combination, a mechanical contrivance which, acting diaphragmatically, acting in the sense of vibrating to and fro, interfered with the sound waves and sent them forward. He would pursue exactly the same line of argument with regard to the tension regulator—would read the functions as described by Edison, read Lord Justice Fry's judgment and Lord M'Laren's judgment, and would then argue that the defendants had infringed the function of the tension regulator, as deduced from all those sources of information. He could not do better for starting his argument than by reading Prof. Forbes: "I say its function is to vary the amount of resistance by greater or less surface contact, which may be done by contact, pressure, or compression, or all three, or any two of them, or any one of them." He (the Attorney-General) had not a mind sufficiently acute to be able to understand this elaborate distinction; but he could show that the witnesses had admitted that there was only a difference of degree, in the sense that when two pieces of wood are leaning against the wall the amount of surface in contact is due to the fact that the one piece presses a certain amount of surface against the other. Some person comes and leans against that piece of wood. The first result, he presumed, would be to increase the area of actual contact, the second result would be to press the two surfaces one against the other, and the last result would be that there would be compression; but he should humbly submit that contact must come first, that pressure must come next, and that compression comes last of all. He could not conceive any compression which was not the result of pressure; he could not conceive any pressure which was not the result of contact. This extraordinary refinement of definition had been invented in the stress and difficulty of the defendants. Prof. Forbes said: "I find not only is there continual reference to the compression of the whole produced in the mass, but that is the only way in which I can conceive the tension regulator here described would act. It is only by the compression of the mass bringing more surfaces into contact that the resistance would be varied." He (the Attorney-General) was for the purposes of this case wholly unable to note the distinction. He would go back to the first description of the tension regulator in the specification. At page 4, line 30: "The motion that the diaphragm receives is the means of producing a rise and fall of electric tension on the line by the devices hereafter set forth." Page 5, line 20: "The circuit to the line must be always closed, and the transmission be produced by the rise and fall of electric tension, resulting several ways." Page 5, line 36: "The fibre is rendered semi-conductive by being rubbed with plumbago, soft metal, or similar material, or by a deposit of metal upon its surface, or by fine particles of conducting or semi-conducting material mixed with it, the conducting power varying with the density of the tuft or brush of fibre." There was a case, as it seemed to him, in which there might be pressure, compression, surface contact, or all three. But speaking generally, at page 6, line 4, not only was there a case in which surface contact was the means, but the patentee had patented it: "In some cases I make use of a variable resistance, resulting from greater or less intimacy of surface contact such as would result from a disc covered with plumbago placed adjacent to a diaphragm, also covered with plumbago or other semi-conducting material, so that the proximity or extent of surface contact will produce rise and fall of tension, the respective parts being in the telegraphic circuit." What right had Prof. Forbes and those other gentlemen to come there and say that Mr. Edison did not mean surface contact when he said it? Everybody admitted that it was a carbon or plumbago contact; it simply was a diaphragm coated with plumbago. If pushing two surfaces coated with plumbago together meant pressure, this was pressure; if it meant surface contact, this was surface contact. Why did they (the defendants) attempt to use that argument? Because they knew they could not get out of surface contact in their transmitter, which they chose to call microphonic contact or action. They knew perfectly well they could not put Prof. Hughes in the box, who independently, he dared say, discovered what had been called the microphone in the year 1878, a year after Mr. Edison's invention. They could not

put him in the box, nor any one of those witnesses who gave evidence before Lord Justice Fry, to allege that it was not surface contact. They said this: "We will go and suggest that it is compression; we cannot even admit that it is pressure. It is compression which has to do the work, and not surface contact." Was it fair, was it right to use such an argument in the face of the patentee, who had himself described in that language the way in which it worked when you had the simple carbon points in contact? He did not know whether it should not be compressed carbon points in the sense of the actual operation. Here was carbon which acted upon a disc. It seemed to be put upon the disc in some way or other, and probably would form something very much like Theiler's transmitter. He wanted to know, for the purposes of description, what difference was there between page 6, line 5, and that which the Court in Scotland found to be an infringment in the sense of being a carbon transmitter such as Edison indicated. His lordship had called it a knocker; it was a metal plate coated with carbon. The sole distinction was that it was hard carbon. What was there to indicate that Edison did not properly describe that? He (the Attorney-General) would show that he actually did describe in his specification that which identically corresponded with this, so far as the sole distinction was concerned, made by the defendants—namely, its being compressed or hard carbon.

MR. JUSTICE NORTH: As I understand it, there (in the Theiler instrument) the knocker is solid carbon.

The ATTORNEY-GENERAL replied that the knocker was metal with a block of carbon behind it. The sole object of arranging it in that particular way was in order to get such a weight that it would remain in contact with the other carbons. Instead of relying upon some mechanical means to keep the one piece of carbon in contact with the other, they had relied upon the weight which was given to the instrument by the piece of metal to affix or to keep the knocker resting against the door. At page 7, line 15, Edison had described fig. 10, which was before his lordship. "h is the resonant chamber, at the end of which is the diaphragm, 10, and at each side of this diaphragm there are springs, c^2, c^3, having points made of compressed plumbago, mixed preferably with gum rubber, but any substance not liable to rapid decomposition, or the elastic or fibrous tension regulator may be used." It was idle for his learned friends to suggest that they were relying upon the elasticity of the gum rubber, from the compressible point of view, because Edison said you need not use gum rubber. What right had they to say the action of that point would not be the action of surface contact, but would be the action of further compression? It certainly was a very strange thing indeed to suggest that, where the patentee had put in the preferable use, language which would cover that use, they were entitled to say, "Because you don't name compressed carbon, but only put in compressed plumbago, mixed preferably with gum rubber or compressed charcoal, your carbon is different." He submitted that there was not a shred of evidence for such an argument. At page 9, line 44: "The object of the U-spring and rubber is to present a semi-rigid point for contact, so as to prevent a rebound and allow of a slight yield when the plumbago is pressed by the diaphragm." What did that mean? You could not compress it, it would rebound, therefore you had the spring keeping it against the diaphragm. At page 10, line 3, was described another form of tension regulator, which was made of lamp-black. It was carbon, the purest form of carbon, mixed with pure plumbago, amorphous phosphorous, and a very small amount of non-conducting material. These were only ways of making tension regulators, not descriptions of the invention—modes of carrying it into effect. In fig. 10 his lordship would see the compressed carbon point resting against the diaphragm. To say that that acted by compression, as distinguished from surface contact and pressure, was an absurdity. It was described in that very instance as pressure at page 7, line 26: "A lessening of the pressure on the plumbago on c^3." In the face of that the scientific gentlemen were to say, for the purpose of getting out of infringement, and for nothing else, that Mr. Edison was all wrong; he did not mean pressure, he meant compression, and in such a sense as to exclude pressure and as to exclude surface contact. What one was entitled to say was that this kind of astute examination of a specification might be all perfectly good and useful where you had got a large number of anticipations which came very close to what the patentee had done. But here they had not got a single one, and the patentee started afresh, and told of something that was entirely new both in operation and design. The claim was: "In an instrument for transmitting electric impulses by sound, the combination with a diaphragm or tympan of electric tension regulators, substantially as hereinbefore described, for varying the resistance in a closed circuit, substantially as set forth." He would ask his lordship to look at the functions of the tension regulator as he had looked at the functions of the diaphragm, and see if his learned friend did not adopt every single function performed by the tension regulator, substantially as described. After allusions to the judgment of Lord Justice Fry, the Attorney-General said the only other matter was the question of the use of the word carbon, and its use as a semi-conductor. This carbon theory had been started in every case, and in every case they had the diamond trotted out as being a reason to show, not that the specification was bad, but that it would not include carbon. A most extraordinary thing in this case was that whereas Edison undoubtedly described lamp-black and plumbago the purest forms of carbon, they had not yet been told what the carbon was that the defendant was using. He wished to remind his lordship that in fig. 10 it was about as hard as it could be. In order to make anything of this point, the defendant must have done one of two things; he must have shown that that which he used did not act as carbon acted in the plaintiffs' specification; he must have shown that although it was a compressed carbon it did not act as Edison's compressed carbon acted, and he had not pretended to do that in the slightest degree. Upon this he could not help noticing that Prof. Forbes admitted, under a little pressure, that compressed plumbago was compressed carbon, in so many words. It was a little strange that these gentlemen should rely upon some assumed special difference between the carbon which they used and the compressed plumbago, which was described in terms in the specification, without adducing a single scintilla of evidence to show that it was different in function, different in chemical constituents, or in anything that would be applicable. It was admitted by Prof. Forbes that it must have resiliency, that it must have elasticity in the sense in which Lord Justice Fry pointed out. He (the Attorney-General) submitted that it was in the highest degree significant that they had not been able to show that their carbon was not the same as Edison's compressed plumbago. Nothing had been suggested to take the place of carbon. Every single tension regulator described by Mr. Edison was to be either actually made of a semi-conducting material or coated with it, and there was not a solitary instance of any substance mentioned that anybody would have thought of who tried to work out Edison's inventions, except those mentioned in his own specification. It was idle to speak of the words semi-conducting being supposed to be misleading. Prof. Forbes said it was a very apt expression. The substance of the thing was this: the line wire was copper or iron—probably copper. You wanted to put into that line wire something which would have a less conductivity than the line wire gave you; you wanted to put it in as a safety valve, something that would control the operation of the electric current in the line wire; you were going to combine in the line wire a very high conductivity something which was of much less conductivity. It would be perfectly apt to describe that as a semi-conductor. Everything else was a million times worse; and amongst them came the diaphragm, which was so bad a conductor that you might use it as an insulator. Prof. Forbes said that conductors were either good or bad. Carbon was the worst of the good ones, and he (the Attorney-General) should have thought that a very apt way of describing it as a semi-conductor. He did not wish to play one man against another, but he could not help asking his lordship to remember that the four witnesses he had called had been dealing with this matter for years, and had consistently given their evidence for years; that evidence had been criticised in every scientific arena in the kingdom. Maclean's case was in the beginning of 1882; that before Lord Justice Fry was about a year later. Those scientific witnesses who put forward the counter theories had disappeared so far as this case was concerned. Here they had two scientific gentlemen giving contrary views. He wanted no better argument in support of his case than the admissions made by Prof. Forbes and Mr. Conrad Cooke, when the matter was put fairly to them, and they felt their scientific reputation would not suffer them to give any other answers. In the instrument of the defendants they had a combination of a mechanical apparatus, by which he meant the red back, the black base, and the mouthpiece, or without the mouthpiece, with a carbon tension regulator; the parts he had first mentioned interfered with the sound waves, took them up and sent tham on to the tension regulator, without a single difference in any material point from the combination which Edison described. This was the third or fourth attempt which had been made to cut down one of the most valuable inventions and extraordinary discoveries ever made, which had revolutionised commercial as well as scientific communication between man and man. He ventured to ask his lordship to say whether this was not an infringement of Mr. Edison's invention.

HIS LORDSHIP intimated that he should reserve his judgment.

Wednesday, August 12th.

The case was down "to be mentioned" this morning, but in the result Mr. Justice North made known his decision.

Mr. MICKLEM appeared for the United Telephone Company, and stated the inability of the Attorney-General to be present.

Mr. BIGHAM, Q.C., attended on behalf of the defendants.

Mr. JUSTICE NORTH said he had hoped to have completed the judgment he had been preparing, but he was sorry to say that he had not been able to do so, and it must, therefore, stand over until after the vacation. At the same time, he did not see any reason why he should not pronounce the order which he intended to make, and, therefore, his judgment was, that the plaintiffs had succeeded, and he must grant an injunction as asked. Then, as regards account or damages, what did the plaintiffs ask for?

Mr. MICKLEM: We ask for damages, my lord.

Mr. JUSTICE NORTH: Very well, then, there shall be enquiry as to damages.

Mr. MICKLEM: We also ask for delivery up of all instruments in the possession of the defendants.

Mr. JUSTICE NORTH: I do not recollect anything being said about that, but I think it follows as a matter of course.

Mr. MICKLEM: We asked for it in our statement of claim. We also asked in our claim for a certificate.

Mr. BIGHAM: I am told they have that certificate already.

Mr. JUSTICE NORTH: Lord Justice Fry did not give it in the case tried before him.

Mr. MICKLEM: No; we were defeated on a technical point before him.

Mr. JUSTICE NORTH: And you succeeded as to the infringement?

Mr. MICKLEM: Yes, my lord.

Mr. JUSTICE NORTH: Yes; you are entitled to that (the certificate).

Mr. BIGHAM: In their own statement of claim they allege that they have that certificate.

Mr. MICKLEM: My learned friend is mistaken. That is in another action altogether; that was in the Bell case.

Mr. BIGHAM: I suppose the enquiry as to damages will proceed during the vacation.

Mr. JUSTICE NORTH: I give no special direction as to that.

Mr. BIGHAM: What I mean is, if it does not, I would ask to stay execution.

Mr. JUSTICE NORTH: Nothing can be done as to that.

Mr. BIGHAM: It is probable that when we see your lordship's reasons, which we shall see when the written judgment is prepared, the parties will consider the matter.

Mr. JUSTICE NORTH: There can be no enquiry as to damages during the vacation; it is not vacation business. As regards taxation of costs, I do not see why that should be done in vacation either. I will stay execution if necessary.

After some conversation,

Mr. BIGHAM: Then is execution to be stayed?

Mr. JUSTICE NORTH: They undertake not to do anything.

Mr. MICKLEM: Of course, the injunction we shall have at once, and we shall have delivery up of all the instruments in the defendants' possession now. There is no reason against that, I think.

Mr. JUSTICE NORTH: Well, I don't know.

Mr. MICKLEM: If we have got our injunction we are surely entitled to have the instruments infringing.

Mr. BIGHAM: There is an injunction granted to him, I understand. I do not ask for any stay as to that. But we do not want to deliver the instruments up at present. I would ask your lordship to let that part of the order remain in suspense until after the vacation, until after your lordship's written judgment has been read.

Mr. JUSTICE NORTH: That is rather inconvenient. Of course they ought to be given up and destroyed. Those you have now can be of no use.

Mr. BIGHAM: We have no objection to deliver them up to any third party. We don't desire to have them, but we don't desire the other side to have them.

Mr. MICKLEM: Let them give them to us, and we will undertake not to use them.

Mr. JUSTICE NORTH: If I have to decide between you, Mr. Bigham, you must give them up. I should have thought the most convenient course would be for the solicitors to arrange.

Mr. BIGHAM: I should have thought so, too.

Mr. MICKLEM: We have tried that, and cannot make any arrangement.

Mr. JUSTICE NORTH: If you cannot make any arrangement about that, what I must do is—there must be no stay of the order, as regards the giving up. The plaintiffs undertake to keep them separate until further orders.

Mr. MICKLEM: Your lordship will be able, perhaps, to sign the certificate immediately, to-day or tomorrow.

Mr. JUSTICE NORTH: It shall be done in the course of two or hree days.

REVIEW.

A Hand-book of Practical Telegraphy. By R. S. CULLEY. Eighth Edition. London: Longmans, Green & Co.

The deserved and widespread popularity which this well-known book possesses amongst telegraphists is amply proved by the fact of an eighth edition being called for. The retirement of the author from active work has necessarily prevented his correcting and adding to the work to the extent which would have been possible had he still been Engineer-in-Chief of the Postal Telegraph Department. The changes which have taken place since Mr. Culley's retirement have been very considerable, and although these changes are to a great extent indicated in the new edition, much has unavoidably been omitted. If we compare the book with the last issue, we find that it contains twenty-six pages less, owing to the excision of obsolete information, and to the re-writing and modernising which has been extensively and advantageously carried on throughout the work. Much of the matter has been re-arranged so as to bring together the subjects or paragraphs which have a direct bearing upon one another. The chief alterations which are noticeable are in the chapters dealing with the quadruplex and the fast speed automatic systems, and with the telephone. The latter subject, however, is dismissed in five pages, in which the original Bell receiver, the Gower-Bell instrument, and the twisted line wire system are described and illustrated. The quadruplex is not dealt with at great length, but the general arrangement of the method as now worked by the Post Office is given, though no details are furnished. A point worthy of notice is the simplification of the diagrams which illustrate the description; this enables the latter to be easily understood. The Wheatstone automatic system, as at present in use, is described; this system has been materially modified recently, with the result that a speed of over 400 words a minute can be obtained over a comparatively long line. The descriptions, generally, are still very meagre as regards the forms and details of instruments in use. We may mention that in the preface the author expresses his obligations to Mr. Graves and Mr. Preece for their help in bringing the eighth edition down to the present time, and also to Mr. Preece and Mr. Chapman for having read some of the most important proofs.

NOTES.

Electric Lighting of Iron Works.—A building is now being fitted up in the Britannia Iron Works, Gainsborough, belonging to Messrs. Marshall, Sons and Co., Limited, for electric light engines and dynamo machines. There will be two rows of engines, four in each row, across the centre of the building, the four dynamos being placed beside them. Each of these is connected to sections of the works that are likely to work extra hours at the same time. The engines are 14 horse-power, of the vertical type made by the firm. There being eight in all, there is a duplicate engine to each machine, but two of these will be used for driving a portion of the smithy. Steam will be supplied by two Lancashire boilers 30 ft. by 7 ft.

The Electric Light in Newspaper Offices.—Last week we quoted the warm praise given by the New York *Sun* to the incandescent light after having tried it for some time in its establishment. The following is the unsolicited testimony of the proprietors of the Evansville *Courier*, in the form of a letter to the *Electrical World*:—"We have a 30-light United States plant in our office, which we put in about the 1st of February. For the benefit of newspaper publishers we wish to give a statement of what the cost has been to us and how much can be saved by using the incandescent lamps in place of gas. We had a good engine and boiler, and hence had no expense in putting in plant except cost of dynamo, wires, wiring and lamps. Our coal bill has been increased $10 per month. Cost of lamps (600 hour guarantee), $15 per month; attendance, $15 per month; making total cost of 30 lights (we have 36 in, but do not use them all at any one time), $40 per month. Gas at $2 per thousand would cost from $80 to $100 per month. Coal, oil, including breakage of lamps and chimneys, and attendance had been costing us over $35 per month. So publishers who have the power will find the incandescent lamp the best and cheapest, and the United States and Weston lamps the best. We have written the above communication unsolicited by the United States Company, and submit it to you for publication or the waste basket, as you may decide."

Electric Power in the States.—The R. I. Electric Power Company, operating under the Daft system, is running a 10 H.P. generator at Providence, U.S.A., and furnishing power for the forges and atmospheric hammer in the engine works of the Harris-Corliss Company, the R. I. Printing Company, and the Hope Glass Cutting Works, and in each case giving absolute satisfaction. They are making preparations to put in a 50 H.P. generator.

Electric Lighting in Art Galleries.—The Manchester Town Council last week considered the report of the Art Gallery Committee on the subject of lighting the Art Gallery by electricity. The matter has been before them since November last, when a sub-committee was appointed, whose report has now been adopted, and, as it is of an interesting character, the *Mechanical World* gives the following particulars of the results arrived at:—The satisfactory character of the light was noticed after a visit to the Liverpool Corporation Free Library and Reading Rooms, where it had been in use for the past five years. Of the seven tenders received, the tender of a local company has been preferred—the Edison Electric Company, the total amount being £1,715. This tender includes two 16 H.P. "Otto" gas engines, with all the latest improvements and necessary fittings; two compound self-regulating Elwell-Parker dynamos, each capable of sustaining 250 lamps; the installation will consist of 385 lamps. The tender includes foundations for engines and dynamos.

Electric Lighting in Brooklyn.—When all the lights now contracted for in Brooklyn are put up, there will be 255 of 1,200 candle-power each. In all, over 1,800 gas lights will be dispensed with. As soon as possible, the whole city will, no doubt, be illuminated with the new light, and the deeds which love darkness will be less frequent.

They would have the Electric Light.—The New York *Electrical Review* states that a decided victory has been scored by the Brush Company at Detroit, Michigan, the City Council accepting this company's proposition to light the city by a vote of 17 to 8. There had been considerable discussion over the question of lighting, and a few favoured going back to gas, but the citizens would not have it, and the result as stated is a well deserved compliment to the present excellent Brush system, which will now be continued.

Electric Lighting for Athletic Grounds. — The Williamsburgh Athletic Club, Brooklyn, has its well-appointed grounds lighted by electricity, by the light of which athletic sports are carried on. The grounds are brilliantly illuminated. The club is one of the strongest in the country, having a membership of 1,200.

The Washington Electric Light Station Rebuilt.—The Washington electric light station, which was burned down recently, is now all right again, the company having promptly put in new machinery in a convenient location, and in less than a week had all the lights burning. The system is the "United States."

Electric Lighting in a College.—A successful installation of a 200-light incandescent plant has been put in the College of Ottawa, Ont. This is the first educational institution in Canada to adopt the electric light.

Gas once more Beaten.—At Rutland, Vt., where the gas used is of the most excellent quality, the Edison Company of Boston recently started an exhibition plant for the purpose of convincing certain sceptics that the incandescent light, which had never before been seen in the town, could compete with the older form of illumination. After the trial plant had been run three nights the unanimous verdict was in favour of the incandescent light, and the proposition of the Edison Company to instal 250 lights, on the three wire system, was at once accepted.

Electric Lighting in Chatham Dockyard. — The necessary arrangements are being made at Chatham Dockyard for lighting the workshops and factories with the electric light, the results of the trials carried out for some time past, in those of the workshops already lighted by electricity, having been found to be satisfactory.

The Mechanical Telephone. — A reporter of the *Financial News* (which paper, by the way, appears to think very highly of this *new and ingenious* invention) recently called at the office of the United Telephone Company, where, he says, the very poorest possible opinion of the new telephone appears to have been formed. He found Mr. Blaikie closeted with Mr. Robinson Kendal, the chairman of the South of England Telephone Company, Limited, who had just returned from an inspection of the mechanical telephone. We give the interview, in our contemporary's own language:—"On being asked what he thought of the instrument, Mr. Kendal said that it reminded him of the toy telephones that are hawked about for 6d. each in the public streets. 'In fact,' said he, 'I can only compare it to two pill-boxes with a piece of string drawn through the centre of each to connect them.' 'I think that they are simply rubbish,' said Mr. Blaikie; 'and as for being able to transmit sound for any distance, why it's absurd.' 'But, will they compete with your company at all?' 'Oh, dear no! They won't affect us in the slightest. They have no rights or patents whatever which can in any way touch us.' 'Mr. Preece gives a very glowing account of the invention, and I suppose he is an authority?' remarked the reporter. 'Mr. Preece is the electrician to the General Post Office,' replied Mr. Kendal; 'and Government officials have no right whatever to give certificates. Why, even a dockyard servant is not permitted to keep a shop, and, on the same basis, Government officials may not give certificates to private companies. When Sir Henry Tyler occupied a post under Government there were questions asked in the House of Commons about his having given certificates for similar purposes, and Sir Stafford Northcote then replied that he was not allowed to do so. I believe that Sir Henry Tyler's resignation was in part due to this. As to the capital of this new concern, why anybody should give £20,000 in cash for a telephone that is not a patent I don't know.' 'When a man wants an instrument he doesn't want a bogus one; he wants a proper one,' volunteered Mr. Kendal. 'It is very much on the principle of the Scotchman who told his father that he was going to marry a widow. "Dunna marry a widow," said the father, "but get a splendid woman," and that is what I say about this mechanical telephone.' 'What course, if any, does the United Company intend taking with regard to it?' suggested the reporter. 'I do not know anything about it yet. Probably there will be a question asked about it in the House.' And then Mr. Blaikie and Mr. Kendal were so intent upon getting at the business which they had in hand that there was no time to talk any more about the new instruments."

Army Telegraphs.—Captain A. H. Bagnold, Telegraph Battalion Royal Engineers, has arrived at Cairo from up the Nile, and assumed duty as Assistant Director of Army Telegraphs for Brigadier General Grenfell's Frontier Force.

Telephone Call Rooms.—Telephone call rooms have just been opened at Clapham and Kilburn, and in response to suggestions made by subscribers, the directors of the United Telephone Company intend to open other rooms throughout London and in the suburbs. Call rooms are already open at Oxford Court, Cannon Street; at 36, Coleman Street; 10, Heddon Street, Regent Street; Lonsdale Chambers, 27, Chancery Lane; the Eastern Hotel, Limehouse; 88, High Street, Clapham; the Red Tower, 54, High Road, Kilburn; the International Inventions Exhibition; and there are also telephones fitted up in the Houses of Parliament for the convenience of members, as well as of counsel and others attending the committees. Rooms will very shortly be opened at Charing Cross, Notting Hill, Camden Town, Chiswick, Sydenham, &c.

Facilities to London Telephone Subscribers.—The directors of the United Telephone Company announce that they are now prepared, subject to their being able in each case to obtain the necessary wayleaves, to connect with the London exchange system for a rental of £12 per annum the private residence of any subscriber who already pays £20 for an exchange wire from his office or place of business. There is no intimation whether any limit as to distance will be observed, but we

cannot imagine that the company will be so generous as to connect a subscriber who resides, say, 50 miles out of town, for the £12 rate. They have connected the company's exchanges with the central telegraph office in St. Martin's-le-Grand. Subscribers can now, therefore, on arranging with the company for the payment of the ordinary tariff charged by the Post Office for the transmission of inland and foreign messages, transmit from, and receive at, their own offices telegrams direct through St. Martin's-le-Grand. The directors do not propose making any extra charge for the increased facility thus afforded. The Post Office, in addition to telephoning messages to a subscriber's address, will also, if he should wish it, deliver the messages in writing by hand in the usual way, and without any extra charge.

Telephonic Charges.—A financial contemporary has latterly been interesting itself in this subject, taking the view that the present rates are much too high. Some remarks of our own, in the REVIEW of June 20th last, will probably be found pertinent on this occasion; and we see that Mr. C. L. W. Fitzgerald, chairman of the Consolidated Telephone Construction and Maintenance Company, has written to our contemporary as follows:—"In one of the leaders in your issue of to-day on telephonic matters, you make a remark which I think ought not to pass unchallenged. You say that telephonic business has not made the progress in London which it would otherwise have made because the service costs too much, and a high tariff exacted, viz., £20 per annum per subscriber to the exchange system. I should like to call your attention to the fact that in New York subscribers pay $15 per month, say £36 per annum; that in Paris subscribers pay 600 f. per annum, which, at 25 f. to the pound, is £24. Now it is well known that London is a most expensive town to work in consequence of the public setting their faces against giving wayleaves; it would thus appear that London is absolutely worked cheaper than either Paris or New York from a subscriber's point of view, and yet we do not hear of telephonic business being hindered in those centres by the high charges made to subscribers. One telephone company in New York, giving a special service, charges £60 per annum per subscriber."

Proposition to Extend the Telegraph in Afghanistan.—The correspondent of the *Times* at Calcutta remarks:—"It has been pointed out—and the suggestion is well worthy of attention—that the Ameer should be moved to consent to the immediate extension of the telegraph to Candahar and Herat. The difficulty of making a line would not be great. A strong ruler like the Ameer could guarantee its safety, and the Indian Telegraph Department could easily train a staff of Mahomedan clerks, whose presence would neither alarm nor irritate the Afghans. Such a line, besides being of the greatest use politically and strategically, would probably soon command a large commercial traffic, for during the British occupation of Candahar the merchants of that place were not slow to learn and avail themselves of the use of the wire. Moreover, when the line was once made to Herat it would be easy to connect it with the Persian system from Meshed and Russian Sarakhs, thus giving a new route between India and England."

The First Atlantic Cable.—"Anglo-American" writes to a contemporary deprecating that Mr. Cyrus Field should have so egregiously taken credit for originating and laying the Atlantic cable, pointing out that the late Peter Cooper and the late Marshall O. Roberts in America, and the late Sir Curtis Lampson in England, are equally entitled with Mr. Field to some of the honour. He suggests the erection of a statue to Sir Curtis Lampson in the Royal Exchange Courtyard, near the statue of George Peabody, his senior partner.

The Registration of Telegraphic Addresses.—In the House of Commons on the 7th inst., Colonel King-Harman asked the Postmaster-General whether, under the Telegraph Acts Amendment Bill, any alteration would be made in the existing system of registration of addresses for telegraphic purposes. Lord John Manners: It is not proposed to make any alteration in the charge or the system for the registration of addresses.

A Telegraphic Error.—One of the officers of the Assize Court at Leeds, on Saturday evening, finding that he was likely to be late, telegraphed to his wife, "Detained in court." It was translated, "Died in Court." Happily, the wife felt sure it was an error.

Telegraph Revenue.—The receipts on the telegraphic service for the period between April 1st and August 8th, 1885, were £600,000; those from April 1st to August 9th, 1884, amounted to £595,000.

The Inventions Exhibition Awards.—In a supplement to the *London Gazette* is a list of awards made to exhibitors at the Inventions Exhibition. The honours consist of gold medals, silver medals, bronze medals, and diplomas of honour. There have been distributed 235 gold medals, 438 silver medals, 515 bronze medals, and 24 diplomas of honour. Gold medals have been awarded the following exhibitors amongst others:—John Bell & Co., treatment of asbestos; Captain Cardew, voltmeter; R. E. Crompton & Co., improvement in electric lighting appliances; Davey, Paxman & Co., engines and boilers; Doulton & Co., general exhibit of pottery; Edison and Swan United Electric Light Company, Edison and Swan systems of electric lighting; Electrical Power Storage Company, improvements in secondary batteries; Fielding and Platt, high speed engine, and also for hydraulic machines for rivetting, forging, and flanging; Walter Glover & Co., James's patent doubling and laying machine, and rope making machine; Gaulard and Gibbs, successful working out of a system of distribution of electricity by induced currents; Greenwood and Batley, high speed horizontal engine; Hathorn, Davey & Co., domestic motor; Heenan and Froude, "Tower" spherical engine; W. T. Henley's Telegraph Works Company, excellence of cables; India Rubber, Gutta Percha, and Telegraph Works Company, India rubber and gutta percha; the late Professor Fleeming Jenkin, telpherage; Kitson and Company, Parson's high speed engine; A. Légé and Company, tide predicting machine, combined recording tide-gauge anemometer, barometer, &c. Phosphor Bronze Company, phosphor bronze alloys; G. Planté (France) secondary battery and scientific research; Saxby & Farmer, railway signals and safety appliances; Siemens Bros. & Co., excellence of electric lighting arrangements; J. W. Swan, incandescence lamps; W. R. Sykes, combined electric interlocking and blocking system for railways; Thomson and Houston, systems of electric lighting (exhibited by Laing, Wharton & Down); S. A. Varley, designing the first self exciting dynamo machine; Watson, Laidlaw & Co., self-balancing electro-centrifugal machine and hydro-extractor (Watts's patent); Henry Wilde, discovery of the indefinite increase of the magnetic and electric forces from quantities indefinitely small; Willans and Robinson, Willans's compound engine and electric governor. The Society of Arts has awarded a gold medal, under the Howard Trust, to Hathorn, Davey and Co., for their domestic motor.

Technical Education.—The Saddlers' Company has established four studentships, each of the annual value of £30, and tenable for two years, at the Finsbury Technical College of the City and Guilds of London Institute. The studentships will be competed for at the entrance examination to be held at the college, on October 1st, and are open to pupils above 14 years of age who are attending or who have attended any public elementary school in the United Kingdom.

The Inventions Exhibition Subway.—It has recently been suggested to us that an electrically worked tramline should have been laid down in this subway to convey passengers to and from the railway station. The idea is a good one, and may, perhaps, be carried out on some future occasion.

The Manufacture of Incandescence Lamps.—The details of the construction of the well-known Cruto lamp, which we publish this week, are interesting, inasmuch as the available literature on this subject is very meagre.

The Electrical Transmission of Power.—M. Hippolyte Fontaine recently remarked that he was quite convinced that, in the present state of practical knowledge concerning the construction of electrical machines, it is practically impossible to transmit 100 H.P. with a single generator dynamo through a resistance of 100 ohms even for one hour. The Creil experiments of M. Marcel Deprez cannot, therefore, in his opinion, be carried out under the conditions laid down. They are as impossible to realise as would be a steam-engine working at a pressure of 500 atmospheres. Theory, in this case, says: *Yes*; but, practice says: *No*. If, says M. Fontaine, it is desired to transmit motive power from Creil to Paris, it can be done without the least difficulty by diminishing the total power to be received at Paris, increasing the section of the conductor, contenting ourselves with a low industrial rendering, employing several generators, &c.

Business Transfer.—We are informed that Mr. E. Thurkle has purchased the old-established business of Homfray and Co.—lately known under the name of J. J. Botten and Co.—and that this will now be combined with his own, and carried on at 5, Denmark Street, Soho.

The Telegraph Conference.—The International Telegraph Conference was opened at Berlin on Monday by Dr. Von Stephan, Postmaster-General. Thirty-three States and seventeen telegraph companies were represented. The various English companies were represented by Mr. John Pender, M.P., Mr. Henry Weaver, Mr. Lewis Weels, Mr. Thomas Fuller, Mr, William Fuller, Sir James Anderson, Sir Julian Goldsmid, Mr. W. Andrews, Mr. F. Moll, Mr. Robinson Kendal, and Major Alexander Wood; while for the English Government were Messrs. Patey, Fischer, and Benton; for British India, Colonel Bateman-Champain, and Mr. C. H. Reynolds; for South Australia, Mr. C. Todd; for Tasmania, Mr. J. Henniker Heaton; and for New South Wales, Mr. E. C. Cracknell; Colonel Smith represented Persia. Dr. Von Stephan opened the sitting with an address of welcome, and was afterwards, on the motion of Mr. Patey, elected president. Two committees, one for the consideration of tariff questions, the other for matters of technical administration, were then appointed. Dr. Stephan thanked the Swiss Government for presiding so successfully over the International Telegraph Bureau (of Berne), and the British Government for duties it had undertaken since the last Conference at London (1875). He also adverted to the memory of several deceased members of that Conference, including Sir William Siemens. Formal business concluded the first sitting. There are nearly 80 delegates at the conference, but only one for each State is allowed to vote; the rest, whether representing States or companies, have only a deliberative voice. Banquets and garden parties occupied Tuesday and Wednesday, and the conference was to have resumed on Thursday; it is expected to continue for the better part of three weeks. According to the *Times*, grave doubts are expressed as to the success of Germany's proposal for the introduction of a reduced European tariff, as this could not very well harmonise with the interests of the private English companies, and it is understood that on this ground more particularly the British delegate will be forced to re-assert the negative standpoint assumed by England at the London Conference.

The Zipernowski-Déri System.—We are desired to state—and no doubt many of our readers will avail themselves of the information—that the Zipernowski-Déri system of distributing electricity, which we have described in recent numbers of the REVIEW, may be seen in working condition at the Edison and Swan Company's stand at the Inventions Exhibition.

Mr. Esson's letter on this subject will be read with considerable interest, and probably lead to further discussion on a matter so fraught with scientific importance. Perhaps the paper we publish by Prof. Ferraris contains enough data to enable our correspondent to base a definite opinion on the merits of the new transformer.

Institution of Mechanical Engineers.—The members of the Institution of Mechanical Engineers last Friday made an excursion to Gainsborough. Before starting they witnessed the experimental lighting by electricity of a train on the Great Northern Railway, the motive power of the arrangement being supplied by the movement of the train. On arriving at Gainsborough the members inspected the works of Messrs. Marshall and Co., and then went to Doncaster, where they visited the Great Northern Locomotive Works, arriving back at Lincoln late in the evening.

Serious Accident on an Electric Tramway.—A serious accident is reported to have taken place on the Bessbrook and Newry Electric Tramway. During last week experiments were conducted with a view to testing the electric machinery, and on Friday evening Mr. Davies, J.P., estate agent for Mr. Richardson, M.P.; Mr. Edmund Davies, his brother; Mr. Harrison, the manager of the line; and James Williamson, the engineer, started in a passenger car from the Bessbrook Junction for a trial trip to Newry. About half-way between Bessbrook and Newry there is a very sharp decline, and when the car had reached this point the electric power was cut off and word given to put on the brake; but from some unexplained cause the apparatus did not work, and the car dashed down at a terrible rate. On reaching Craigmore it was seen that two empty goods trucks were standing on the line about half a mile ahead, and the occupants of the car, recognising that if they remained where they were they would meet with certain death, jumped out, and were hurled on to the line with terrific force. Mr. William Davies was thrown on his face and rendered unconscious, Mr. Edmund Davies sustained severe injuries, and the driver was thrown on his head and cut severely. The car rushed on, and striking the trucks, threw one on the other and both off the line.

Tramcar Propulsion by Electricity.—We understand that there is at present in the works of the North Metropolitan Tramway Company an electrical locomotive intended for use upon that company's line. This engine has been running on a private line for several weeks, and so far satisfactorily. The locomotive is 10 feet long by 6 feet wide, and externally is very much like the steam locomotives at Stamford Hill. The system adopted is that of using accumulators as the motive power, and the laminated armature of the motor is of Walker's construction, having eight divisions and 32 coils. With a current of 38 ampères, and at 800 revolutions per minute, the motor develops 3·2 brake horse-power, its weight being 287 lbs.

Whitworth Scholarships.—Scotland, at least Glasgow, has again done well in the matter of scholarships. H. O. Bennie and Wm. F. Calderwood, both students for four years at the College of Science and Arts, were 2nd and 5th, respectively, with £150 each, while James Rorison and Robert Smith, formerly of the same college, and last year of Anderson's, were 8th and 14th with £150 and £100 respectively. Mr. Bennie, in addition, has gained one of the four Royal Exhibitions, open to all comers, entitling him to £50 per annum for three years, and free access to the lecture and laboratory courses at the Royal School of Mines.

Underground Wires in Chicago.—The New York *Electrical World* states that underground work in Chicago is proceeding at a rapid pace. The conduit company is extending its conduits, and the electric light, telephone and telegraph people are getting more and more of their wires beneath the surface.

A Canadian Electrical Railway.—The Van Depoele Company has just secured a contract for building an electrical railway at Toronto, Ont., to carry the passengers to the coming Industrial Exposition there. The railway which the Van Depoele Company had there last year, an experimental one, is said to have been a perfect success, and to have carried 200 passengers to each train. The present road will be extended to the city and run in connection with the city railways, and is to become a permanent institution.

Discovery of Mica.—A recent discovery of mica at Tallulah, Ga., is reckoned the richest in the world. It is said that blocks a foot square can be taken out, and that the supply is declared inexhaustible. There is such a demand for the mineral in stove making that it has been growing scarce and dear for several years.

Paget Higgs, Limited (In liquidation).—Notice is given that all parties having claims against Paget Higgs, Limited, some time carrying on business as electricians at 58B, Rose Street Lane South, Edinburgh, are required to lodge the same with Mr. Andrew Scott, 29, St. Andrew Square, Edinburgh, liquidator of the company, within one month from July 31st.

The Leeds Electric Lighting Dispute.—We learn that this dispute, now fortunately at an end, was occasioned by a misunderstanding of the terms of the specification, each party maintaining its own view to be the correct one, and being so advised by the respective scientific authorities called in. The contractors were willing to entertain the same terms as are now arranged three months ago. A few days before the date set down for the trial, which should have taken place at York, Messrs. Paterson and Cooper were approached by the corporation with a view to settlement. Terms were arranged, as the contractors were advised that in the event of winning the action the costs attached thereto would be far in excess of those incurred by an amicable settlement. The corporation, however, gave an undertaking that it should be made perfectly clear that Messrs. Paterson and Cooper never admitted themselves, for one moment, to be in the wrong, and that the arrangement was made simply to save the expense of legal proceedings, such an array of scientific experts on either side being engaged.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Portable Electric Safety Lamp Company, Limited.—The statutory return of this company, made up to the 6th inst., was filed on the 8th inst. The nominal capital is £100,000 in £5 shares. The only shares at present issued are the seven subscribed for by the signatories to the memorandum and articles of association. Upon these shares £3 has been called, the calls paid amounting to £3 10s., leaving £17 10s. unpaid. Registered office, 2, George Street, Mansion House.

LEGAL.

Edwards v. Dennis.—Re Edwards's Trade Mark.—These were appeals relating to the same subject matter. The first case was an appeal by the defendant from a decision of Mr. Justice A. L. Smith, granting an injunction against him. In "Re Edwards" Mr. Edwards appealed from a decision of Vice-Chancellor Bacon rectifying the registration of his trade mark. The plaintiff was an iron merchant and manufacturer at Birkenhead. His business was originally carried on by Mr. W. F. W. Rees, under the firm of Cromar, Scott & Co., who in 1879 registered a trade mark of Neptune with a trident and the word "Neptune." The plaintiff was not a manufacturer or seller of iron wire, but a manufacturer of galvanised iron plates or sheets, nor did the business at the time he purchased it include the manufacture of wire. The defendant, W. F. Dennis, was the agent in England of Felten and Guilleaume, manufacturers, at Mulheim, near Cologne, of galvanised iron wire, and in March, 1880, they registered a mark, previously used by them, representing a trident, with the word "Neptune" and the letters F. G. The plaintiff obtained in the action an injunction from Mr. Justice A. L. Smith against the user by the defendant of this trade-mark, on the ground that it was an infringement of the mark of the plaintiff. After this decision Messrs Felten and Guilleaume obtained an order from Vice-Chancellor Bacon limiting the registration of the plaintiff's trade-mark. Lord Justice Cotton, in delivering judgment, said the object of the Trade Marks Registration Act (1875) was not to give new rights, but to place restrictions on the bringing of actions for infringement of trade-marks, and also to facilitate evidence of title to trade-marks by means of registration. The business of the plaintiff, and of the company from which he purchased, did not include the manufacture of wire, and therefore the registration ought to be rectified, not in the way directed by the Vice-Chancellor, but by limiting it to marks used in connection with galvanised and other iron sheets. Although the Court had varied this order, Mr. Edwards must pay the costs of the appeal from it. Lord Justice Lindley and Lord Justice Fry also delivered judgments in favour of the defendant and his principals.

The Irwell Indiarubber Company, Limited.—Mr. Hemming, Q.C., and Mr. Joseph Gatey, on behalf of a shareholder of the above company, moved, before Vice-Chancellor Bacon, on Friday, the 7th inst., for the appointment of an official liquidator to act in conjunction with Mr. Nicholls, the present official liquidator. It was alleged that Mr. Nicholls's former connection with the company was such as to bring his duties into conflict with his interests, and that an impartial person was needed to act with him. Mr. Millar, Q.C., and Mr. Swinfen Eady, in opposition to the motion, were not called upon. The Vice-Chancellor said that the affidavit which had been read charged the liquidator with falsehood, dishonesty, and fraudulent use of his powers; and with this person so charged the applicant asked to have himself associated as liquidator. A more absurd and unfounded application there could not be. If there were any truth in the charges that had been made the door was open to the complainant to have them investigated in a proper manner. The application must be dismissed with costs.

CITY NOTES, REPORTS, MEETINGS, &c.

The National Telephone Company, Limited.

THE fifth annual ordinary general meeting of the shareholders was held on Friday, the 7th inst., at the offices of the company, 11, Queen Victoria Street; Colonel R. Raynsford Jackson, the chairman of the company, presiding.

The notice calling the meeting was read by Mr. William B. Campbell, the secretary.

The report of the directors, submitted to the meeting, was as under:—

Capital Expenditure.—The capital expenditure for the year has been £53,290 17s. 1d. against £35,249 2s. 11d. in the previous twelve months.

Revenue.—The annual gross revenue on the 30th June was £70,943 11s. 3d., against £57,271 15s. 2d. at the corresponding date of the previous year, showing an increase of £13,671 16s. 1d.

The gross revenue allocated to the past year is £62,525 18s. 6d., against £49,952 10s. 4d. allocated to the previous year, and the amount carried forward to next year is £38,641 13s. 10d., against £31,013 3s. 5d. carried forward last year.

Dividends.—After providing for the accrued interest on the debentures, the usual dividend of 6 per cent. on the preference shares, and having paid an interim dividend for the first half of the year at the rate of 2 per cent. per annum on the ordinary capital, £11,605 5s. 6d. will remain as the balance of profit. Out of this the directors propose to allot a further sum of £5,625 to the payment of a dividend at the rate of 2½ per cent. per annum on the ordinary capital for the second half of the year; and as they consider it advisable that, instead of carrying forward a large balance, a reserve fund to meet special contingencies should be inaugurated, they have set aside for that purpose the sum of £5,000, leaving £980 5s. 6d. to be carried forward.

Trunk Wires.—The company has erected trunk wires to connect different towns in various parts of its territory as well as to substitute in Yorkshire and the Midland districts those rented from the Postmaster-General.

It derives two kinds of revenue from trunk wires—one from rentals and the other from fee messages. The revenue from renters is growing slowly, whilst that from fee messages shows a steady and continuous monthly increase.

In Scotland the company still rents trunk lines from the Postmaster-General between Glasgow and Edinburgh, Glasgow and

Greenock, and Glasgow and Paisley. The revenue derived from these wires covers the rental paid to the Post Office, and thus the period of loss on trunk wires has gone by.

Licenses.—The late Mr. Fawcett justified an anticipation expressed in the last report of the board, by making broad and important alterations in the terms of the Post Office licenses granted to the telephone companies. Their effect is to largely increase the freedom of action of the companies and to relieve them from regulations and restrictions which prevented their giving an adequate telephonic service to the community.

The larger freedom thus given has enabled the directors to open exchanges in several towns which, under the old license, could not have been given the benefit of the company's system.

The company's exchange business is still subject to a Post Office royalty of 10 per cent. on the gross revenue of the company, and it has acquired the right, under the new license, of connecting telephonically different persons and firms upon payment of a similar royalty of 10 per cent.

The co-operation of the permanent staff of the department in bringing these changes into operation has been given in the loyal spirit which it has been the pleasant duty of your directors to acknowledge on former occasions.

The United Company's Royalties.—The directors of the United Telephone Company, having liberally recognised the wisdom and force of suggestions put before them, have framed a new royalty arrangement, the altered nature of the incidence of which is calculated to assist the development of telephone business. This new arrangement has been offered to the United Company's licensees, and your directors have thought it the interest of this company to accept it.

The United Telephone Company continues to defend its patents successfully against infringers.

The Chairman said: Gentlemen, I shall move the adoption by the shareholders of the directors' report, and shall occupy your attention only an extremely short time, because the reports and accounts of the company are complete in themselves, and put you in possession of all that it is necessary you should know respecting its affairs. I will, however, for a reason which will afterwards appear, call your attention to the increase in the gross revenue of the company. You will see that on the 30th June, 1884, the gross revenue had reached £57,271 15s. 2d., and that on the 30th June last it had reached £70,943 11s. 3d. You will see, therefore, that there is a considerable increase in the gross revenue, and I am happy to say that the increase in the net revenue has been relatively greater. The net revenue for 1884 was £15,227 0s. 5d., and for the year ended 30th June last £23,658 10s. 3d. I have only called your attention to these figures because I wish to point out to you that no increase of the revenue of a telephone company can take place without an expenditure of capital. A telephone company is in a different position to almost any other undertaking in that respect. Take, for example, a railway. When a railway has been constructed at a given expenditure for the railway itself and for the plant, the traffic may be large or it may be small, and it may grow very considerably without the investment of additional capital. On the other hand, in a telephone company, if you obtain an additional number of subscribers, you can only connect them with the telephone system by an outlay for wires, standards, plant, &c., which necessarily involves the investment of capital. So, if you wish for any large increase of the revenue, you can only obtain it by corresponding investments of money. You may, therefore, I think, safely assume that if a telephone company is properly conducted, and if its capital is soundly invested, then the amount of capital devoted to the development of its business is a fair criterion of the success of the company. I beg to inform you, although most of you, I think, will have received the circular containing the resolutions which will be proposed at a meeting to be held next Tuesday, that on that day a proposal will be put before the shareholders for an increase of the capital of this company, and the effect of your sanction to the issue of that additional capital, and of its investment, will be doubtless to increase the prosperity of the company, and to add to the dividend on the ordinary shares. The capital expended during the last year was £53,290 17s. 1d. That was a larger amount considerably than in the previous year, and I think the shareholders may naturally inquire why the larger amount has been spent. You are aware that the license of the Postmaster-General, under which the company carries on its business, was altered last year, and that larger powers were given to the companies. Amongst those powers was the right to erect trunk wires in substitution of those previously rented from the Postmaster-General, and to have its own wires to connect town with town. The company has largely availed itself of the privilege, and spent about £10,000 in doing so. Of course we have not as yet received a satisfactory return upon that expenditure, but the revenue is growing. We have two kinds of trunk traffic—namely, that derived from the ordinary rentals and that from those who pay for fee messages. The latter revenue is steadily increasing from week to week, and there is every prospect of its attaining, in the course of time, a large development, and being a valuable source of income to the company. When we took over Messrs. Graham's telephone business in Glasgow they had about 200 subscribers, and it was part of our bargain that they should have the right to erect and maintain our wires in Glasgow and within a radius of 25 miles around. But we found that contract disadvantageous, and all the work done under it extremely costly. We therefore entered into negotiations with Messrs. Graham, and bought the contract from them. The purchase of that contract cost us something over £7,500. I congratulate the shareholders upon the completion of that transaction. The effect has been to diminish, to a very great extent, the cost of working the Glasgow system; in mere maintenance alone the saving from that cause has been very large, and the saving in the cost of construction is so considerable that we have undertaken works in connection with our Glasgow district, which we certainly should not have ventured to construct had that contract been in existence. You are aware we have acquired considerable additional territory from the United Telephone Company; an expenditure of about £2,200 was involved in connection with the acquisition of that territory. The expenditure proper for the increase of our ordinary revenue was £34,000, and the result of that outlay has been, I think, extremely satisfactory. I only know, so far, of one item of expenditure of importance in the current year. You are aware that we had a serious opposition in Dundee, where there was a rival company called the Dundee and District Telephone Company, and in order to carry on our contest with that company we were obliged to reduce our tariff to the low figure of £5. I need not tell you that we lost money heavily during the continuance of the contest with that company. When I was last in Scotland I succeeded in making an arrangement by which that business was conveyed to us upon payment to the local company of £8,500. By our arrangement with the United Company we are not allowed to possess instruments, but have to use the telephones of the United Company. That company, therefore, took over the instruments, and purchased them from us. So the actual cost of the purchase of the Dundee and District Telephone Company was not excessive, and the effect will be a considerable increase of our revenue from that town, where I have no doubt the company will henceforth possess a valuable telephone property. Dundee is connected with many of the surrounding places by trunk wires, and I do not suppose that there is any telephone system more perfect than that in Dundee and the vicinity. It is connected with Perth, Arbroath, and Forfar, and is about to be connected with other places. A good deal has been said about the telephone tariffs, and many complain that they are unduly high; but those who make that complaint speak, I think, in ignorance of several important facts. Some of them say that the telephone charges in this country are the highest in the world. They are not aware, perhaps, that there are more telephones in the United States than in all of the rest of the world put together. When the telephone was first introduced there, a great many exchanges were started upon low tariffs, and the companies thought they were making very large profits, but in the course of time they found the expenses so much greater than they anticipated that, instead of earning profits, they were losing money, and the effect was a general increase of telephone tariffs in America. I think our subscribers would be somewhat disagreeably surprised if, in this country (where we are said to adopt the highest rates), we were to adopt those current in America—that is to say, £35 per subscriber, which is the rate charged in New York, Philadelphia, and other great American towns. The fact is, you cannot adopt the same tariff in every town. The cost of working the telephone varies according to an infinite variety of circumstances. In some towns you are obliged to adopt a high tariff, and in others you can work it lower. As far as the National Telephone Company is concerned, it has been its aim to give its services upon economical terms to the subscribers. Therefore, in some places you will find the tariff is remarkably low, and that is due to the fact that we have been able to make it so without disadvantage to the company. In other towns it is necessarily higher, as the expenses in those towns are greater. I do not think it necessary to dilate further upon this subject, or, indeed, upon any of those matters which interest the shareholders, because, as I said in the beginning, our report seems to deal with everything which is of genuine interest. (Hear, hear.) I will, therefore, say nothing more, unless in answer to questions which may be put by shareholders present. I move the adoption of the report.

Mr. J. P. Bigelow seconded the motion.

Mr. George Pugh asked whether the reserve fund was invested separately, or used in the business of the company.

The Chairman said it was not specially invested, but was used in the business. It was the intention of the directors to add to that fund from time to time.

The resolution for the adoption of the report and accounts, which included the declaration of the dividends, was then put to the meeting, and carried unanimously.

The Chairmnn moved that Mr. John Bruce, of Edinburgh, be re-elected a director.

Mr. S. D. Williams seconded the motion, which was put and carried.

Mr. Pugh moved the re-election of Mr. W. A. Smith, of Glasgow, as a director, which was seconded by Mr. S. D. Williams, and carried.

Mr. Bigelow moved the re-election of Mr. Jeremiah Garnett, of Manchester, which was seconded and carried.

On the motion of Mr. Cargill, seconded by Mr. Pugh, the auditors, Messrs. Quilter, Ball, and Company, were re-elected.

On the motion of Mr. Bigelow, seconded by Mr. Ness, a cordial vote of thanks was passed to the chairman and directors.

The Chairman acknowledged the compliment, and the meeting broke up.

AN extraordinary general meeting of the National Telephone Company, Limited, was held at the offices of the company, 11, Queen Victoria Street, on Tuesday, under the presidency of Colonel R. Raynsford Jackson, the chairman.

There was only a small attendance, several shareholders being represented by proxies.

The Secretary (Mr. Wm. B. Campbell) having read the notice convening the meeting,

The Chairman said: Gentlemen, it is not my intention to preface the moving of the resolutions by any observations, because I dwelt upon the subject which this meeting has to deal with very fully at a meeting of the shareholders on Friday last, and I will, therefore, simply move—

"That the capital of the company be increased by the issue of 15,000 new shares of £10 each."

This was seconded by Mr. J. P. Bigelow, vice-chairman of the company, and agreed to.

The Chairman also moved—

"That such shares be called second preference shares, and that the holders thereof (subject to the payment of the preferential dividend on the original preference shares), be entitled to a cumulative preferential dividend at the rate of 6 per cent. per annum. After the ordinary shares have received a dividend at the rate of 6 per cent. per annum out of the profits of each year, the second preference shares and the ordinary shares shall participate ratably, according to the amounts paid up thereon, in any surplus profits."

Mr. G. F. Harrison seconded the motion, which was also carried.

The third resolution, also moved by the Chairman, ran thus:—

"The second preference shares shall not confer any right of voting at any general meeting of the company, and in the event of the company being wound-up, the surplus assets thereof shall be applied, in the first place, in repaying to the holders of the original preference shares, the full amount paid up thereon and subject thereto in repaying to the holders of the second preference shares the full amount paid up thereon in priority to any payment in respect of the ordinary shares of the company."

Mr. W. A. Smith having seconded this, and it being also carried, the business of the meeting then terminated with a vote of thanks to the chairman.

American, British, and Continental Cable Company, Limited.—The creditors of this company are requested to send in the particulars to the official liquidator by October 1st next.

Great Eastern Syndicate, Limited.—A petition for winding up this syndicate is to be heard before the vacation judge on the 19th inst.

TRAFFIC RECEIPTS.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending July 31st were £3,325.

NEW PATENTS—1885.

9332. "Periodically adjustable electric switches." H. HART. Dated August 5.

9388. "Electric tramways." M. VOLK. Dated August 6.

9415. "Electric batteries." J. H. JOHNSON. (Communicated by L. A. W. Desruells.) Dated August 7.

9442. "Glazed earthenware conduits for subterranean telegraph and telephone lines." EARL POULETT. Dated August 8.

9480. "Magnetic compasses." E. A. REEVES. Dated August 8.

9522. "Electrical accumulators or storage batteries." C. P. Elieson. Dated August 10.

9526. "Electro-dynamic motors." T. J. HANDFORD. (Communicated by F. J. Sprague.) Dated August 10.

9527. "Motors for electric railways." T. J. HANDFORD. (Communicated by F. J. Sprague.) Dated August 10.

9530. "Telephonic transmitting instruments." S. P. THOMPSON. Dated August 11.

9544. "Electrical signalling lamp, and electrical battery to be used in conjunction therewith, and for other purposes." E. G. CRAVEN. Dated August 11.

9563. "Galvanic bands and plates for curative purposes." D. B. MACQUEEN, H. WILKIE. Dated August 11.

9564. "Electrical synchronous movements." A. L. PARCELLE. Dated August 11. (*Complete.*)

9569. "Apparatus for controlling signalling apparatus and points of railways by electricity." E. J. HOUGHTON. Dated August 11. (*Complete.*)

9570. "Generating currents of voltaic electricity." R. H. COURTENAY. Dated August 11.

9570 (? 9571). "Electric table lamps and general domestic electric light." R. H. COURTENAY. Dated August 11.

9580. "Preparing and producing insulating for electrical purposes." A. MUIRHEAD, C. R. A. WRIGHT. Dated August 12.

9601. "Electro-magnets; applying same." H. W. RAVENSHAW. Dated August 12.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1885.

2350. "An improvement in magnetic compasses." A. M. CLARK. (Communicated from abroad by Messrs. Favi, Paride and Company, of Italy.) Dated February 20. 4d. According to this invention, the compass box is made of cast iron, the card of sheet iron, and the gimbals of wrought iron. The construction of the compass is the same as in ordinary, and differs only in the metal of which it is constructed, the rings, box, bearings, &c., being all made of wrought or cast iron in suitable proportion, with the object, more especially in the case of iron vessels, of neutralising the local attraction of the iron of which they are constructed, and of concentrating this magnetic force in the compass, whereby the needle is rendered no longer liable to deviation.

2168. "Improvement in electrotype plates and the mode of securing them in the forms for printing." A. W. MARSHALL and O. J. SMITH. Dated February 17. 4d. The object of this invention is especially to improve the means by which newspapers at a distance are furnished printing matter from a central office in the form of stereotype plates, and it consists in substituting for such plates an electro-shell made of flexible material, without the heavy metal backing now in general use, and in providing such shell with edges extending out beyond the line of the printing surface to form flanges, whereby the shell may be adapted to a block for the purpose of printing.

2194. "Improvements in electric railways." SYDNEY PITT. (Communicated from abroad by Leo Daft, of New Jersey.) Dated February 17. 6d. Relates to transmitting power, especially for the propulsion of moving engines upon tracks by electricity, and it consists in transmitting the power over conductors, not necessarily highly insulated, by means of a current of electricity of such low tension that the escape from the conductors occasions a comparatively small loss, while at the same time the conductors are not necessarily protected from accidental contact with animals or human beings, which has heretofore in many cases been necessary.

3518. "Holder for incandescent electric lamp." A. KHOTINSKY. Dated March 18. 4d. Fig. 1 is a vertical section, and fig. 2 is a plan of a holder according to the invention, suited for a lamp the bulb of which has a metallic casing, A, at its base. B is the holder made of wood, ebonite or other non-conducting material. Its lower end terminates in a screwed stem, C, tapered so that it can be screwed into an ordinary gas pipe instead of the usual burner; or, the lower end of the holder may be tubular as indicated by the dotted lines, D, so that it can be put on a burner or on a supporting stem. The interior of B is hollowed to receive a metal nut, E, which is in metallic connection with one of the wire terminals, F. The other terminal, G, is in connection with a strip of metal, H, which is let in edgeways into B. A screw, K, has a head, L, to which one of the wires, W, from the carbon of the lamp is attached, the other of these wires, W^1, being attached

FIG. 1.

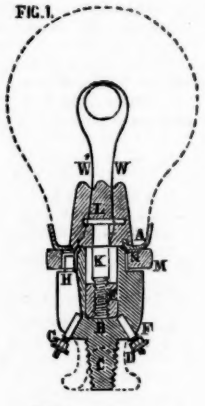


FIG. 2.

to the metal base, A. The hollow in the base of the bulb is filled in with non-conducting material which fixes the head of K in it. A ring, M, of non-conducting material, is fitted to turn round between the collar of B and the base, A. On this ring is fixed a metal spring, N, one end of which, n, by its upward spring bears against A, the other end, n^1, turning down into a recess which, as shown in fig. 2, extends from n^1 to H. The screw, K, being screwed into the nut, E, the lamp is held in position, and by turning the ring, M, about one quarter round so as to bring n^1 close against H, the circuit of the lamp is closed, there being now passage for electricity by F, E, K, L, W and the carbon to W^1, A, n, n^1, H and G. To extinguish the lamp it is only necessary to turn M partly round so as to separate n^1 from H, thereby opening the circuit.

4723. "Improvements in aerial electric signalling apparatus." F. J. MICKLEWRIGHT. Dated April 16. 6d. The inventor provides a primary or a secondary battery, or a dynamo electric machine, driven by an engine or other available motive power, and he causes the electric current to be conveyed from said battery or dynamo by positive and negative wires in the usual manner to a switch-board, and thence by means of an insulated cable to a frame containing one or more electric lamps or semaphore indicators, the current being carried to the lamps or semaphores aforesaid by the requisite number of wires in cable. The aforenamed frame may be affixed to any convenient object having a sufficient altitude for the purpose for which the signals are required; for instance, the frame may be attached to a ship's mast, or to a lighthouse, or to a lightship, or the frame may be attached to a captive balloon, so that from an altitude a code of signals may be visible for a long distance (see the REVIEW for July 11th).

4745. "Improvements in galvanic cells." S. RAUDNITZ. Dated April 17. 2d. The inventor employs zinc and carbon electrodes; the zinc may be surrounded by pure water alone, as sufficient acid penetrates the porous cell from outside the carbon electrode, but it makes no difference of any importance if the fluid around the zinc pole consist of dilute sulphuric acid, or of any alkaline liquid, chloride of natrium, or sodium natrium sulfuricum, dilute muriatic acid, &c., or dilute chlorides of mercury may be employed. As depolarising agent the inventor employs a mixture of three different solutions, which is placed around the carbon electrode, and out of which Aqua regia, the above-mentioned mixture of muriatic acid and nitric acid in diluted solution is formed in statu nascendi, as soon as the circuit is closed, and a current goes through connecting the two electrodes of zinc and carbon. The three solutions consist of:—1. From 1½ to 2 litres of water, with addition of from ½ to ¾ kilogramme of saltpetre (nitrate of soda or kali). 2. From 1½ to 2 litres of water, with addition of from ½ to 1½ kilogrammes of sulphuric acid. 3. From 1½ to 2 litres of water, with addition of from ½ to 1 kilogramme of muriatic acid.

5302. "Actuating dabbing brushes for combing wool and other fibrous substances by electricity." J. J. RICHARDSON. Dated April 29. 4d. The inventor connects the crank or eccentric of the motor, driven by electric power, by means of a connecting rod, to the vertical rods or frame attached to the dabbing brush, or by other attachment of a similar nature, thereby communicating a vertical reciprocating motion to the dabbing brush. He places the motor either over the dabbing brush or at the side of it, working it direct from the spindle of the motor, or may fix it under the table of the combing machine. The electrical arrangement for giving the necessary power for driving the dabbing brush, consists of stationery field, and rotary magnets, driven by dynamo or voltaic electricity, in combination with suitable condensers, which are placed in the circuit, to prevent sparking, and to neutralise the retarding effects of the secondary currents.

5235. "Improvements in telephone transmitters." J. E. FULLER. Dated April 28. 6d. The object of the invention is to furnish means by which the limit of variation in the strength of an electric current is increased or made greater than heretofore. The invention is applied to an electric current, which, upon being made vibratory by the variation of impact between the electrodes, is used for the transmission or reproduction telephonically of speech signals, and all kinds of sounds that can be made to produce vibratory motion in diaphragms. The invention is intended to render such transmission or reproduction more perfect and clear than heretofore.

5293. "A semaphore indicator for electric bells." J. D. ADAMS. Dated April 29. 4d. The semaphore is fitted outside each room in the corridor, and is provided with an arm made to drop down when an electro-magnet is excited. It is painted red or some other bright colour, so that when it falls it is conspicuous from the other end of the corridor, or any other desired distance. The arm is normally held in a vertical position, and hid from view in its case by a small catch on the armature of the magnet; but when the visitor rings the bell and completes the circuit by the contact button, a current passes through the magnet, depresses the armature, and releases the semaphore arm which drops into a horizontal position through a slit in the case and presents itself in a conspicuous manner. At the same time, the current passes through an electro-magnet in the indicator box in the service room, and causes a pendulous tablet to swing before an opening in the indicator box, and display the number of the room where the bell has been rung. This pendulum indicator is actuated by an armature placed between two electro-magnets, and is of a well-known form.

CORRESPONDENCE.

The Transformer System of Distributing Electricity.

The description of the Zipernowski-Déri system of electric distribution in your issues of the 1st and 8th insts., I have read with interest, inasmuch as in the transformer there described I recognise the development of an idea which occurred to me some time ago. Mr. Gibbs at a meeting of the Society of Engineers in April last read an interesting paper on the Gaulard and Gibbs apparatus, and in the discussion which followed I called attention to the fact that in the transformers as at present constructed the columns were magnetically insulated from each other, that the magnetic curves had for the most part to be completed in air, that these curves ought to be completed in iron, and that the iron wire columns ought to be supplanted by a ring core similar to the Gramme armature on which the primary and secondary coils could be wound, the inductive effect being in consequence of this arrangement very largely increased. To practically carry out the idea I proposed when discussing the matter with my firm to try as a preliminary experiment the effect of using a Phœnix dynamo armature as a transformer, the alternate sections of the armature being connected up as primary and secondary coils, but, although facilities were offered for a trial of the apparatus months ago, other business of more importance has hitherto persistently occupied our attention.

It will be noticed that the plan I then proposed is exactly similar to that described by Messrs. Zipernowski and Déri, and illustrated in fig. 1, the other devices mentioned being mere modifications of the same fundamental idea of completing the magnetic circuit through iron. The system of Messrs. Zipernowski and Déri, therefore, though doubtless original, is not quite novel.

So much for the form of the apparatus, but while discussing the matter of transformers generally it may not be out of place to offer a few further suggestions regarding their working, which I ventured to make on the occasion above referred to, but which were considered highly heterodox by those directly interested in the system.

In the ELECTRICAL REVIEW of March 21st are published the experiments of M. Pietro Uzel on the Gaulard and Gibbs transformers at the Turin Exhibition, and curves are exhibited showing the relation between the difference of potential at the terminals of the secondary coil, and the resistance in the secondary circuit of a large transformer, the current through the primary, of course, remaining constant.

It will be noticed that in this transformer, within wide limits, the difference of potential at the terminals of the secondary increases very nearly in proportion to the resistance in the secondary circuit; in other words, the transformer, as constructed, disregarding any outside regulating device, is practically a constant current apparatus pre-eminently fitted for lighting lamps *in series* and utterly unsuited for lighting lamps *in parallel*. It is, doubtless, possible to construct an apparatus which shall give a constant difference of potential at the terminals of the secondary, and thus enable us without any extraneous adjustment to light lamps in parallel, but in the case before us, where the current is approximately constant, it seems out of the question to connect the lamps in parallel and necessitate for regulating purposes adjustments more or less complicated when for a series arrangement of lamps the apparatus is practically self-regulating.

One objection there is to lighting incandescence lamps in series, but only one, if a lamp breaks the whole of the lamps on that particular circuit go out. But if two or three transformers are employed with their circuits zig-zaged this objection loses its weight—and it must be remembered that the breaking of good lamps is now happily becoming a rare occurrence—moreover, in the case of the low voltage lamps which would have to be employed the danger of breakage is reduced to a minimum. With this method the work done in the primary is a maximum where the lamps lit are a maximum; when there are no lamps lit the work done in the primary is a minimum, the secondary being then short-circuited. The lamp circuit is never open; to put out lamps they are short-circuited, to light them the short circuiting switches are opened.

It has been asked why employ transformers at all if the lamps on the secondary circuit are in series? The answer

is that there can never be on the consumer's circuit a greater difference of potential than that required to light the particular lamps chosen, and that there is, therefore, not the slightest danger to him since the main cable may be so heavily insulated and so carefully protected that it is impossible for the consumer to touch it, indeed it is quite unnecessary that any part of it be exposed. By employing transformers one consumer is entirely independent of another, which would not be the case with a simple series system, and by connecting up the lamps to the transformers in the way here described, the necessity for the more complicated parallel main system of Messrs. Zipernowski and Déri is done away with.

Regarding the latter system, we await with eagerness details and figures relating to the performance of these transformers constructed for constant difference of potential. This system forms a new departure in the distribution of electricity, but in the absence of data it cannot yet be criticised in relation to the results obtained.

W. B. Esson.

Distribution of Electricity by Inductional Transformers.

Having given some attention to this subject, I read with interest the description of the method of distribution adopted by Messrs. Paris and Scott. I must, however, agree with our esteemed editors in their opinion of the system. It seems impossible, for many reasons, that such an apparatus will prove as efficient as the induction coils tested by Prof. Ferraris; nor is this method of transformation by any means original, precisely similar apparatus having been

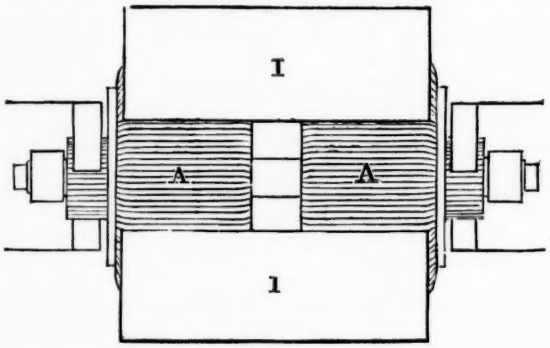


FIG. 1.

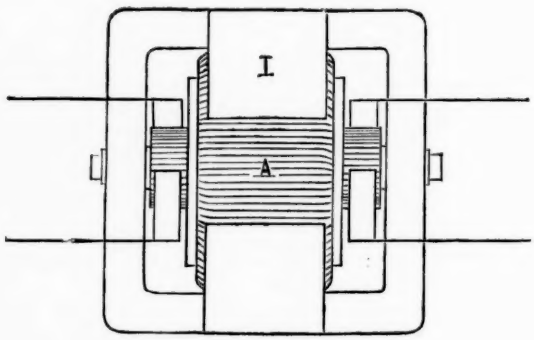


FIG. 2.

devised by Edison, Zipernowski, and others. About a year ago I proposed such a transformer, consisting of two armatures and a single field magnet. The primary current traversing the coils of the field magnet and those of one of the rings, causes the former to rotate, thereby generating a current in the secondary armature.

Subsequently I designed an improved form, having stationary soft-iron inductors without wire coils.

Fig. 1 shows the principle of this apparatus, A, A, being the two armatures fixed upon the same axis, and I, I, the soft iron inductors. When a current is sent through one of the armatures both rotate, the inductors are magnetised by the current which traverses the primary armature, and currents are induced in the coils of the secondary ring.

Fig. 2 indicates another system in which there is but one armature wound with two circuits. The current in passing through the primary coils of the armature causes it to revolve, and also magnetises the inductor of soft iron, inducing a current in the wires of the secondary circuit.

As for the utility of these devices, I consider it obvious that they would be found more economical than the motor and dynamo system, or those transformations by accumulators; but in competition with the induction coil, in which there are no frictional losses, they would be considerably at a disadvantage—that is unless the distribution by means of alternating currents is found to present serious difficulties in practice.

F. de Wolffers.

The Brooks Underground Cable System.

I hardly know whether Mr. Frempt, in your issue of the 11th inst., wishes to impugn my statements or those of the member of the Philadelphia Councils regarding the Brooks underground cable between Jersey City and Newark.

In either case it seems strange that he should consider the cable good, as a whole, when a single wire only out of 30 was working.

If it is any satisfaction to him, I am willing to admit that the lifetime of the cable exceeded somewhat its actual use in service—perhaps by three or four months. The reason, however, was this: After a conductor was connected (August 17th) and failed (October 19th, 1882), it was deemed expedient, considering previous experience, not to connect other wires right away, but to let the cable remain for possible emergencies, in winter, when its use for even a week, with our overhead wires prostrated by sleet, would have gone some ways towards paying for the "experiment." From this you will observe that we could not well do without wires of some kind, Mr. Frempt's statement to the contrary notwithstanding. That, by the way, is on a par with his other statement respecting the final abandonment, for the purpose of killing underground bills.

As a sample of the cable's performance when but *five* wires were connected in circuit, I append a specimen report from Mr. Bogart after he was instructed to use it:—

[COPY.]

"New York, *January 23rd*, 1883.

"G. A. Hamilton, Esq., Electrician's Office.

"Following is a synopsis of the working of the Brooks underground since first connected, January 9th:—

"January 11th.—9.35 a.m., 24 condr. grounds; 1.10 p.m., 12 condr. grounds.

"January 12th.—10 a.m., Nos. 12 and 24 condr. O.K. again end connected as in starting schedule; 12.50 p.m., 12 and 24 crossed together, 24 outclears 12.

"January 13th.—8 a.m., 24 condr. tests clear and connected through as per schedule; 10.50 a.m., 24 condr. grounds.

"January 15th.—8 a.m., 17 condr. grounded, 12 and 24 condr. crossed together, 24 outclears 12.

"January 16th.—Nos. 3, 8, 12 and 17 condrs. working O.K. all day; 24 crossed with 12 and out.

"January 17th.—8 a.m., 24 condr. grounded; 9 a.m., 12 condr. grounded.

"January 18th.—8 a.m. to 5.30 p.m., 12 and 24 grounded, 3 and 17 crossed together, 17 outclears 3.

"January 19th.—8 a.m. to 5.30 p.m., 12 and 24 grounded, 3 and 17 crossed together, 17 out.

"January 20th.—8 a.m. to 5.30 p.m., 12 and 24

grounded, 3 and 17 crossed together; 1.35 p.m., 3 gounded, and outbalance day.

"January 22nd.—8 a.m. to 5.30 p.m., 3, 12, 17, and 24 condrs. grounded, 3 and 17 also crossed together. At present we are working but one condr. (No. 8). Shall I connect in new conductors in place of those that have failed?

"Very respectfully,

"(Signed) S. S. BOGART, per B.W."

Other reports of a similar nature are on file. The above, however, was enough to call out lamentations quite equal to those of our Hebrew friend when he learned that the "peutiful" cavalry boots he had sold a customer had been used for walking purposes. In his language, they readily epitomise into, "Mein Got! vhy didn't you say you vanted a telegraf kabel!!"

G. A. Hamilton.

New York, *July 29th*, 1885.

Secondary Batteries and Electric Lighting.

I think that it is desirable to point out to those who use the electric light, and especially when an accumulator is employed, the great importance of putting switches in all mains which shall "cut" both leads at once, and one such switch should always be placed close to the cells.

In the installation here all line switches are constructed after this manner and it is found very convenient, for, apart from safety, all work on the wires can be done without fear of "shock." To give one illustration of the advantage gained by using such switches. The other day one of the leads showed a fault; the double line switch by the cells was "cut," and the mains were then found in good order, hence the leakage was at the accumulator. Now, if the usual method of "cutting" one line only had been employed, it is easy to see that some considerable difficulty might have been experienced in localising the fault, and especially if the switch had been in the line which was not faulty. An experienced man will always find a fault, but as a rule ordinary men are put to this work. Thus a double line cutting switch is a source of safety as well as a means to facilitate testing.

Not having seen this point mentioned before, leads me to venture addressing you upon the subject.

David Salomons.

Broomhill, Tunbridge Wells,
August 10th, 1885.

Electrical Measuring Instruments.

I take the liberty of asking who can supply me with a measuring instrument suited for alternating, as well as direct currents of 0·0001 to 0·0500 ampères, of which at least one fourth is calibrated direct on scale? The apparatus serving for practical purposes, the scale is to be read without mirror and telescope.

Dr. Julius Donath.

Budapest, Göttergasse 3 (Hungary).

Underground Wires.

I think it would be very interesting, and there are probably others of your readers of same opinion, to have some particulars of the insulating materials described in the paper on "Underground Wires" in your issue of the 1st inst. Can you, perhaps, kindly give such information, or say where it may be obtained?

The material called "renti" may be some modification of the Kerite core introduced by Mr. Day some years ago; but my particular curiosity is aroused by the "Faraday" cable, which seems to possess some truly remarkable properties. I presume the cable alluded to as having a capacity of 0·06 microfarad per mile was of this material, but this figure must surely be a mistake, for, even with the low specific inductive capacity given, a simple calculation will show that with the *maximum* resistance named the core would be of an impracticable size. It is not usual to express "*specific* inductive capacity" "*in microfarads*," and a slight consideration of the figures suggests doubts of their accuracy. The value given for gutta-percha, for instance, is one that is now practically obsolete so far as our best makers are concerned.

A few results of actual electrical tests, with the dimensions of the cores tested, would be of more value than figures arranged as in above paper.

W. C.

10th August, 1885.

Electric Signalling from a Balloon.

I see that the letters of James W. Vickers and "J. H.," in *Invention*, August 1st, concerning the Bruce balloon have been quoted in your paper, and if you would kindly also publish the following reply I should esteem it a favour.

In the above-mentioned letters I see that my claim to this particular form of signalling balloon is disputed in favour of Mr. Thwaite, C.E. I have not the honour of knowing Mr. Thwaite, personally or by name. The claim of Jas. W. Vickers and of "J. H." seems to amount to this: that some months ago—at the time that I myself was designing this balloon—Mr. Thwaite thought of a combination of electricity and balloons, these last to be made in grotesque shapes for strategetic purposes, and that he ventilated these ideas, though this knowledge did not reach me.

Now, I do not imagine that Mr. Thwaite and I are the only two persons in the world who have thought of a combination of electricity and balloons; but for my arrangement I distinctly claim originality of thought and execution, and I am fully prepared, if necessary, to defend this claim. My balloon is intended for *flashing* lights, and not only for illumination. This has entailed many original and special contrivances—so the statement of "precisely similar" is utterly incomprehensible—which I have carried through in the face of many practical obstacles. I have priority and dissimilarity of thought. Had I neither my claim to invention would hold good, for does not the honour of an invention belong to him who has combined unprompted thought with execution? If priority of thought constitutes invention, then, I am afraid, I must also claim the illuminated grotesque shape by a period of one year and a half, though I should be sorry if my friends claimed an invention for me on so feeble a plea.

Many navigators planned and mapped the whole journey to the New World, though I do not think the Old World would accord them the discovery in preference to Columbus. The division and sub-division of electric light was the idea of many scientific men, but does that entitle them all to the honour which belongs to such men as Crookes, Swan, Edison? Apologising for intruding on your space,

Eric Stuart Bruce, *M.A. Oxon, M.S.A.*

Exeter College, Oxford, *August*, 1885.

Mechanical Telephones.

A paragraph has been going the round of the daily papers *re* a new mechanical telephone, said to be recently imported from America, and the prospectus of a company formed for the purpose of introducing this instrument is being widely circulated.

It does not appear to be sufficiently well known that mechanical telephones are by no means new, but are, in fact, much older than those that employ electricity, and that it is therefore entirely beside the truth to state, as does the paragraph in question, that the invention of Messrs. Knudson and Ellsworth is new in principle and substantially different from all telephones at present before the public.

Mechanical telephones were first invented or introduced into Europe about twenty years ago, but it is said that a rude form of these instruments has been in use among the natives of India and China for centuries.

Millar, of Edinburgh, Heaviside and Nixon, of Newcastle-on-Tyne, and Huntley, have made many and varied experiments with them, and have succeeded in transmitting speech by means of a metallic wire in conjunction with diaphragms of metal, wood, and cardboard, up to distances of half a mile, which appears to be about the extreme limit.

Irish, of Sunderland, has now for more than two years been selling a mechanical telephone, so instruments on this principle have now been in the market for some time, though they do not appear to have come much into practical use.

The chief difficulty connected with instruments of this class for short distances (for long distances they are *entirely* useless) is the matter of supporting the wires, as at every point of contact there occurs a very great loss of power, and where the wire has to turn round corners the difficulty is still further increased.

Another objection is the continuous humming noise due to the action of the wind on the wire, which is very disagreeable and could not be tolerated in many situations. This can be obviated by securing the wire when not in actual use, but this necessitates the employment of electric bells for call purposes, which considerably complicates matters.

The instrument of Messrs Knudson and Ellsworth seems to differ only as regards the material of which the diaphragm is constructed from the older forms, and though it is quite possible that the new instrument is a distinct improvement on the old, still £42,000 seems a large sum to pay for a patent, the chief part of which appears to be for a mere piece of wicker work.

The following are the chief objections common to all instruments of this nature :—

1. They are unsuited for any but very short distances.
2. They are entirely useless for exchange work.
3. Great difficulty is experienced when the wires have to be supported in even a few places, and where corners have to be circumvented.
4. It is difficult to maintain the wires in the taut condition necessary for the effective working of the instruments.
5. Where the wires pass through partition walls, holes of sufficient size are necessary to allow the wires to go through without touching anything.
6. The wires must be overhead, and cannot possibly be laid underground.
7. A disagreeable humming noise is continuously emitted by the instruments, owing to the vibration of the wires by the wind and other causes.

Having had some experience with mechanical telephones, I trust I may safely say that the electric telephone companies need have little or no fear of their non-electrical rival.

"Telephonist."

August 8th, 1885.

Compound Wound Dynamos.

The data of compound winding of dynamos may be divided into three parts, each of which may be separately considered.

The first part consists in ascertaining how far the field magnet should be magnetised beyond its critical point.

The second part consists of ascertaining the proportion between the mass (weight) of wire in the shunt coil and that in the direct circuit coil ; assuming the current's density is the same in each coil under normal conditions.

And the third part consisting in determining the resistance "or size of wire" to be given to the shunt circuit coil, in terms of the above proportion, the direct circuit coil's resistance, and the normal or "most general" resistance of the external circuit.

It is upon the first two parts only of this subject that I need treat.

Assume a hypothetical dynamo, that is run at a constant speed, to be compound wound in such a manner that either of its field magnet coils is able to keep the field magnet "saturated," then such a dynamo would tend to keep its electromotive force constant with any external resistance ; but the energy expended in maintaining the magnetic field would, with the most general external resistance, be at least four times as great, as if the dynamo wound in such a manner that the two field magnets together only could maintain the magnetic field ; and, however great the external resistance might become, the energy expended would still be twice as much.

If, however, the dynamo is so wound that the two coils together does not magnetise the field magnet far beyond its critical point when the external circuit has its normal resistance, then if the external resistance varies the dynamo would tend to keep the difference of potential at the terminals constant, rather than its electromotive force ; but, in this instance, the range through which the external resistance might be varied would be smaller than in the first case. It, therefore, seems advisable to more or less supersatuate the magnetism of the field magnet, as the range over which the external resistance varies is greater or less ; so that the machine will partake more of the nature of a dynamo wound for constant electromotive force, as the range through which the external resistance varies is greater, or more of the nature of a dynamo wound for constant difference of potential at the terminals, as the range through which the external resistance varies is less.

Although the distance of the strength of the magnetic field, from its critical point, tends to give a compound wound dynamo more of the nature of a constant electromotive force : while the nearness of the strength of the magnetic field to its critical point, tends rather to keep the difference of potential at the terminals constant ; yet it should be observed that the greater the electrical efficiency of the machine, the more nearly the electromotive force, and the difference of potential at the terminals vary directly as each other ; and the more necessary is it, also, that the dynamo should be wound for a constant electromotive force ; that is, it becomes the more necessary that the dynamo should have its magnetism farther from the critical point, in order that the field may remain stable when the external resistance is varied.

In portioning out the space of the bobbins of the field magnet between the direct circuit and the shunt coils, there are two things to be considered ; firstly, what comparative action shall each coil exert on the core ; and, secondly, what portion of the space of the bobbin shall be occupied by each coil, so that each coil shall produce this predetermined amount of action on the core when the current's density in each coil is the same.

If the external circuit af a dynamo is more liable to an increase of resistance beyond its most general value, than to a decrease, it would be advisable to let the shunt field magnet coil exert a greater action than the direct circuit coil. But if a decrease of the external resistance is as much to be anticipated as an increase, then it would be better for the two coils to exert an equal action upon the core.

The space on the bobbin may be divided between the two coils, so that they are side by side, or the one coil may be placed outside the other ; if the two coils are side by side, the length of each coil must be proportioned to the action it is required to exert ; and if the one coil is outside the other, then the depth of each coil must be proportioned to the action it is required to exert. In the former case, the mass of wire in each coil would be proportional to the relative action the coils exerted on the core ; while in the latter case, the mass of wire in each of the coils would be proportional to the depth of the coils multiplied by their mean radius.

W. Moon.